MEMOIRS

OF THE

CARNEGIE MUSEUM.

1901-1904.

VOL. I.

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PREFATORY NOTE.

The first volume of the Memoirs of the Carnegie Museum is brought to its conclusion with the publication of Dr. William H. Ashmead's exceedingly important Monograph upon the Chalcidoidea, the descriptive portion of which is based upon the collections made in South America by Mr. Herbert H. Smith, now the property of the Carnegie Museum. No less valuable from a scientific standpoint than the concluding paper of the series embodied in this volume are the papers of Mr. Hatcher on Paleontology and the Osteological Monograph of Dr. Shufeldt.

It is with a feeling of satisfaction that the Editor contemplates the issue in final form of this volume, which marks the initiation in the city of Pittsburgh of an enterprise which is destined to give to it as the years go by an enduring reputation as a center of scientific culture. To the fame of Pittsburgh as the seat of some of the most Cyclopean industries of the age is being added reputation as a seat of learning. Under the cloud of smoke, which attests the industry of her inhabitants, and is the sign of her material prosperity, live men who find their pleasure in exploring the wonders of the material universe, and the record of their discoveries and researches will from year to year be found in the Annals and the Memoirs of the great Museum which the more than princely generosity of Mr. Andrew Carnegie has called into being. Here are being brought together from all over the globe materials for study illustrating the different arts and sciences, and upon these collections is destined to be built up an extensive literature, which will add to the sum of human knowledge. Among the first fruits of this movement the following pages are found, and they are submitted to the attentive regard of students throughout the world in the confident belief that those who are capable of correctly estimating the value of such publications will find in them both pleasure and profit.

W. J. Holland.

The Carnegie Museum,
March 31, 1904.

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MEMOIRS

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CARNEGIE MUSEUM.

VOL. I. NO. 1.

DIPLODOCUS (MARSH): ITS OSTEOLOGY, TAXONOMY, AND PROBABLE HABITS, WITH A RESTORATION OF THE SKELETON.

By J. B. Hatcher.

The bringing together of a fairly representative collection of fossil vertebrates is a work not only entailing the expenditure of considerable sums of money, but one which also calls for no little skill, energy, and ability on the part of those to whom the work is entrusted, whether they be curators, preparators, or collectors. The experienced student of vertebrate fossils alone realizes how exasperating are the many disappointments in his chosen branch of science. Many of these are unavoidable and will appear most unexpectedly even after he has been careful to eliminate those formerly due to improper field or laboratory methods by the employment of such painstaking care and improved methods of collecting and preparation as were unknown to his predecessors. Where a generation ago the extinct vertebrate life of America was but poorly represented in our museums by imperfect series of teeth and isolated bones, we are now able to study many of these extinct animals from more or less complete skeletons. For these improved conditions we are mainly indebted to the late Professor Marsh, either directly by reason of the vast collections acquired by him, or indirectly through the improved laboratory and field methods developed by him and his assistants.

It may be fairly said that there are no duplicates in any collection of vertebrate fossils, no matter how extensive such collection may be. Owing to the vicissitudes to which each skeleton was subjected immediately after the death of the animal and prior to the imbedding of the bones in the matrix, or to other vicissitudes attending

the subsequent exhumation of the remains, especially to such part of this work as has been accomplished by nature, there has resulted in the first instance, as a rule, only a partial preservation of each skeleton, and in the second, frequently the complete or partial destruction of such parts of the skeleton as were preserved in the first instance. It seldom happens that in two fossil skeletons, or even skulls, no matter how perfect they may appear, there will not be exhibited in one characters wanting in the other, due either to age, sex, or differing degrees of preservation.

Of the many exasperating disappointments just referred to, that mentioned by Professor Osborn in the second paragraph of his introduction to the description of a skeleton of *Diplodocus*, published as Part V., Vol. I. of the Memoirs of the American Museum of Natural History, may be cited as a common example. He says, in speaking of the discovery of the specimen, "At one time strong hopes were aroused that the entire animal would be found together. The long tail stretched off parallel with the cliff, interrupted only by a small gulley which had cut through a small section of the caudals. In front of the sacrum the dorsals stretched forward in a promising way, but the centra were wanting, and finally nothing but the neural arches remained." Strikingly similar disappointments have attended the discovery and unearthing of at least a half dozen other skeletons of *Diplodocus*. Happily, however, in the preserved and recovered remains of these various skeletons different parts of the frame are represented; so that by combining all, we are enabled to study the restored skeleton almost in its entirety, though still incomplete, in at least one important character, to wit, the fore feet.

The difficulties arising from the fragmentary nature of which most remains of vertebrate fossils consist when found imbedded in the rocks, are greatly increased in the Dinosauria by the enormous size attained by the individual animals in many genera. These difficulties are especially applicable to *Diplodocus* and the allied genera constituting the Sauropoda, which include the remains of the largest land animals known to science. These animals frequently attain to a length of over sixty feet, and there is evidence that representatives of some of the larger genera fell but little, if any, short of one hundred feet in length. Every student of the modern Cetacea is well aware of the great difficulty encountered in undertaking a comprehensive study of the osteology of that order of mammals, due chiefly to the trouble and expense incurred, on account of their size, in bringing together, preparing and caring for, sufficiently complete osteological collections. In the Dinosauria these difficulties are rendered infinitely greater, so that the task of bringing together an even fairly representative collection in any one institution, even though its resources may be considerable, is rendered exceedingly difficult, if not quite hopeless.

It is only by encouraging the collecting and investigation of the remains of these extinct and gigantic reptiles in as many institutions as possible, and by combining the results of all, that we may hope eventually to be able to trace the phylogeny of the different genera of Dinosaurs, in respect to the nature of which we are as yet quite ignorant.

The obstacles to a systematic study of the Dinosauria just enumerated serve only to increase the importance of the discovery of any additional information regarding the structure and affinities of the different genera, and to render desirable the early publication of such information. This is especially true when, as in the present case, recent discoveries have brought to light many important and hitherto unknown skeletal features and made it possible to describe, almost in its entirety, the osteology of an animal belonging to a genus, which is representative of a great and highly interesting suborder, as yet known only from fragmentary skeletons of different individuals, which for the most part pertain to different genera and species.

The material upon which the present paper is based belongs for the most part to one of two skeletons (Nos. 84 and 94).[1] The former skeleton was collected by Dr. J. L. Wortman and party during the expedition of 1899, while the latter was secured by Mr. O. A. Peterson and his assistants during the expedition of 1900, while engaged in making further excavations in the same quarry on Sheep Creek, in Albany County, Wyoming, which had yielded Dr. Wortman such excellent material during the previous season. Aside from these two skeletons of *Diplodocus* this quarry, or bone deposit,[2] has furnished a skull and considerable portion of the skeleton of *Stegosaurus* as well as a great part of the skeletons of *Brontosaurus* and numerous remains of other Dinosaurs as yet undetermined.

For all this, and much other valuable material, brought together by the expedition of 1899 conducted by Dr. Wortman and those of 1900 carried on by Mr. Peterson under the direction of the present writer, we are indebted to the well-known generosity of Mr. Andrew Carnegie, the founder of this institution.

The work of freeing the bones from the matrix and preparing them for study has been carried on under the immediate direction of Mr. A. S. Coggeshall, chief preparator in the paleontological laboratory. In this work Mr. Coggeshall has shown exceptional skill and patience. He has been assisted by Mr. Louis S. Coggeshall and Mr. A. W. Vankirk, and in the winter months especially, by Mr. O. A. Peterson, the well-known collector as well as skilled preparator of vertebrate fossils.

[1] The numbers in this paper refer to the Department numbers in the Card Catalogue of Vertebrate Fossils in the Carnegie Museum.

[2] Known as Quarry D on field labels and notebooks.

The original photographs from which many of the figures have been made are by Mr. A. S. Coggeshall, while the drawings were made by Mr. Rudolph Weber and Mr. W. J. Carpenter.

The first skeleton (No. 84) has been entirely freed from the matrix and is found to consist of the right femur and pelvis complete except for the left ilium, which is for the most part wanting, right scapula and coracoid, two sternals, eighteen ribs and forty-one vertebræ divided as follows: fourteen cervicals including the axis, eleven dorsals, four sacrals, and twelve caudals. These vertebræ are for the most part fairly complete, though unfortunately the sacrals and anterior cervicals are more or less injured. This series of forty-one vertebræ are believed to pertain to one individual and to form an unbroken series from the axis to the twelfth caudal, although as was shown in a previous paper,[3] there is some evidence that there are perhaps one or more interruptions in the series and that one or more vertebræ are missing. On the other hand, as will appear later, it is not entirely impossible that at least one vertebra of this supposed series pertains to a second individual belonging perhaps to a distinct genus.

Of the second skeleton (No. 94), which pertained to a somewhat smaller individual than the first, there is a left femur, right tibia, fibula and foot, a complete pelvis, both scapulæ and coracoids, and one sternal. These remains were found associated with a few chevrons, fragments of ribs, forty-seven vertebræ consisting of nine cervicals, eight dorsals, twenty caudals, and eleven other vertebræ which have not as yet been sufficiently freed from the matrix to determine their characters. There were also a second pair of ischia, thus demonstrating the presence of remains of at least two individuals among these bones which were for the most part found scattered over an area about twenty feet square situated a short distance (8–35 ft.) south of the position occupied by the anterior cervicals of the first skeleton. (See Plate I., showing diagram of Quarry D from which the remains were taken.)

In addition to the material already mentioned reference will be made to other remains in the collection of this museum, consisting for the most part of disassociated bones, but belonging undoubtedly to *Diplodocus*, while for the sake of completeness in the description of the skull and dentition recourse will be had to the published memoirs of Professor Marsh and free use will be made of the excellent description by Professor Osborn of the splendid series of caudals in the collections of the American Museum of Natural History.

[3] See Science, N. S., Vol. XII., pp. 828–830, Nov. 30, 1900.

The Skull.

Unfortunately there is no skull of *Diplodocus* in our collections.[4] For completeness the figures and descriptions of the skull and lower jaw of this genus given by the late Professor Marsh in his "Dinosaurs of North America" are introduced here.[5] Fig. I., of the text, and Figs. 1, 2 and 3 Plate II., are after Marsh, and his description accompanying these figures is as follows:

"The skull of *Diplodocus* is of moderate size. The posterior region is elevated and narrow. The facial portion is elongate and the anterior part expanded transversely. The nasal opening is at the apex of the cranium, which from this point

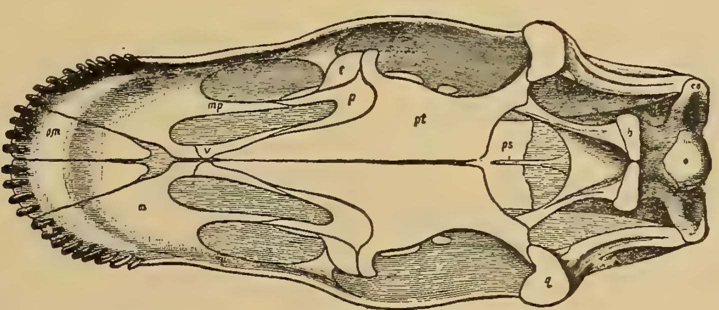


Fig. 1. Skull of *Diplodocus longus* Marsh. One-sixth natural size; seen from below; *b*, basioccipital process; *eo*, exoccipital; *m*, maxillary; *mp*, maxillary plate; *o*, occipital condyle; *p*, palatine; *pm*, premaxillary; *pt*, pterygoid; *ps*, parasphenoid; *q*, quadrate; *t*, transverse bone; *v*, vomer. After Marsh.

slopes backward from the occiput. In front of this aperture the elongate face slopes gradually downward to the end of the muzzle, as shown in Pl. II., Fig. 1.[6]

"Seen from the side the skull of *Diplodocus* shows five openings: a small oval aperture in front, a large antorbital vacuity, the nasal aperture, the orbit, and lower temporal opening. The first of these has not been seen in any other Sauropoda, the large antorbital vacuity is characteristic of the Theropoda also, while the other three openings are present in all the known Dinosauria.

"On the median line, directly over the cerebral cavity of the brain, the type specimen of *Diplodocus* has also a fontanelle in the parietals. This, however, may be an individual peculiarity.

"The plane of the occiput is of moderate size, and forms an obtuse angle with the fronto-parietal surface.

[4] The skull of *Diplodocus* reported in Science, Nov. 9, 1900, p. 718, when freed from the matrix proved to belong to *Stegosaurus*.

[5] Part I., Sixteenth Annual Report, U. S. G. S., pp. 143–244, Plates 2–85, with 66 text figures.

[6] References to plates and figures are altered to agree with numbers for the same in the present paper.

"The occipital condyle is hemispherical in form, and seen from behind is slightly trilobate in outline. It is placed nearly at right angles to the long axis of the skull. It is formed almost wholly of the basioccipital, the exoccipitals entering but slightly or not at all into its composition. The basioccipital processes are large and rugose. The paroccipital processes are stout and somewhat expanded at their extremities, for union with the quadrates.

"The parietal bones are small and composed mainly of the arched processes which join the squamosals. There is no true pineal foramen, but in the skull here figured (Plate II.) there is the small unossified tract mentioned above. In one specimen of *Morosaurus* a similar opening has been observed, but in other Sauropoda the parietal bones, even if thin, are complete. The suture between the parietals and frontal bones is obliterated in the present skull, and the union is firm in all the specimens observed.

"The frontal bones in *Diplodocus* are more expanded transversely than in the other Sauropoda. They are thin along the median portion, but quite thick over the orbits.

"The nasal bones are short and wide and the suture between them and the frontals is distinct. They form the posterior boundary of the large nasal opening, and also send forward a process to meet the ascending branch of the maxillary, thus taking part in the lateral border of the same aperture.

"The nasal opening is very large, subcordate in outline, and is partially divided in front by slender posterior processes of the premaxillaries. It is situated at the apex of the skull, between the orbits, and very near the cavity for the olfactory lobes of the brain.

"The premaxillaries are narrow below, and with the ascending processes very slender and elongate. Along the median line these processes form an obtuse ridge, and above they project into the nasal opening. Each premaxillary contains four functional teeth.

"The maxillaries are very largely developed, more so than in most other known reptiles. The dentigerous portion is very high and slopes inward. The ascending process is very long, thin, and flattened, including near its base an oval foramen, and leaving a large unossified space posteriorly. Above, it meets the nasal and prefrontal bones. Along its inner border for nearly its whole length it unites with the ascending process of the premaxillary. Each maxillary contains nine teeth, all situated in the anterior part of the bone (Pl. II., Fig. 1).

"Along their upper margin, on the inner surface, the maxillaries send off a thick, ened ridge, or process, which meets its fellow, thus excluding the premaxillaries

from the palate, as shown in Fig. 1. Above this, for a large part of their length, the ascending processes of the maxillaries underlap the ascending processes of the premaxillaries and join each other on the median line.

"The orbits are situated posteriorly in the skull, being nearly over the articulations in the lower jaw. They are of medium size, nearly circular in outline, their plane looking outward and slightly backward. No indications of the sclerotic plates have been found either in *Diplodocus* or in the other genera of Sauropoda.

"The supratemporal fossa is small, oval in outline, and directed upward and outward. The lateral temporal fossa is elongated, and oblique in position, bounded, both above and below, by rather slender temporal bars.

"The prefrontal and lachrymal bones are both small; the suture connecting them and also that uniting the latter with the jugal, cannot be determined with certainty.

"The postfrontals are triradiate bones. The longest and most slender branch is that descending downward and forward for connection with the jugal; the shortest is the triangular projection directed backward and fitting into a groove of the squamosal; the anterior branch, which is thickened and rugose, forms part of the orbital border above.

"The squamosal lies upon the upper border of the paroccipital process. The lower portion is thin and closely fitted over the head of the quadrate bone.

"The quadrate is elongate and slender, with its lower end projecting very much forward. In front it has a thin plate extending inward and overlapping the posterior end of the pterygoid.

"The quadratojugal is an elongate bone, firmly attached posteriorly to the quadrate by its expanded portion. In front of the quadrate it forms for a short distance a slender bar, which is the lower temporal arcade.

"The palate is very high and roof-like, and composed chiefly of the pterygoids, as shown in Fig. 1. The basipterygoid processes are elongate, much more so than in the other genera of Sauropoda.

"The pterygoids have a shallow cavity for the reception of these processes, but no distinct impression for a columella. Immediately in front of this cavity the pterygoids begin to expand, and soon form a broad, flat plate, which stands nearly vertical. Its upper border is thin, nearly straight, and extends far forward. The anterior end is acute and unites along its inferior border with the vomer. A little in front of the middle a process extends downward and outward, for union with the transverse bone. In front of this process, uniting with it and with the transverse bone, is the palatine.

"The palatine is a small semi-oval bone fitting into the concave anterior border of the pterygoid, and sending forward a slender process for union with the small palatine process of the maxillary.

"The vomer is a slender triangular bone, united in front by its base to a stout process of the maxillary, which underlaps the ascending process of the premaxillary. Along its upper and inner border it unites with the pterygoid, except at the end, where for a short distance it joins a slender process from the palatine. Its lower border is wholly free."

The Lower Jaws.

The lower jaws are also wanting in our collections and the following brief description is taken from Marsh, as are also the figures referred to:

"The lower jaws of *Diplodocus* are more slender than in any of the other Sauropoda. The dentary especially lacks the massive character seen in *Morosaurus*, and

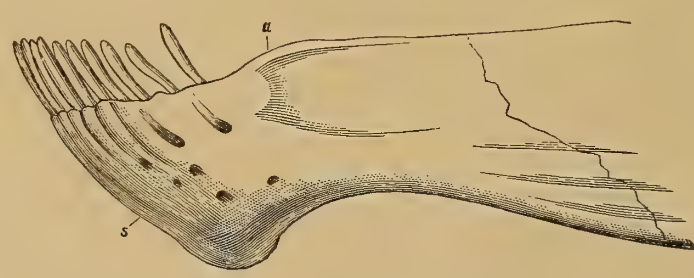


Fig. 2. Dentary bone of *Diplodocus longus*, seen from the left. One third natural size. *a*, edentulous border; *s*, symphysis. After Marsh.

is much less robust than the corresponding bone in *Brontosaurus*. The short dentigerous portion in front is decurved (Pl. II., Fig. 1), and its greatest depth is at the symphysis, as shown in Fig. 2. The articular, angular and surangular bones are well developed, but the coronary and splenial appear to be small."

The Teeth.

Marsh says, "The dentition of *Diplodocus* is the weakest seen in any of the known Dinosauria and strongly suggests the possibility that some of the more specialized members of this great group were edentulous. The teeth are entirely confined to the front of the jaws (Pl. II., Fig. 1), and those in use were inserted in such shallow sockets that they were readily detached. Specimens in the Yale Museum show that entire series of upper and lower teeth could be separated from the bones supporting them without losing their relative position * * *."

"The teeth of *Diplodocus* are cylindrical in form and quite slender. The crowns are more or less compressed transversely and are covered with thin enamel, irregularly striated. The roots are long and slender and the pulp cavity is continued nearly or quite to the crown. In the type specimen of *Diplodocus* there are four teeth, the largest of the series, in each premaxillary, nine in each maxillary, and ten in each dentary of the lower jaw. There are no palatine teeth.

"The jaws contain only a single row of teeth in actual use. These are rapidly replaced, as they wear out or are lost, by a series of successional teeth more numerous than is usual in these reptiles. Fig. 3 represents a transverse section through the maxillary, just behind the fourth tooth. The latter is shown in place, and below it is a series of five immature teeth, in various stages of development, preparing to take its place. These successional teeth are lodged in a large cavity, which extends through the whole dental portion of the maxillary. The succession is also similar in the premaxillary teeth and in those of the lower jaws."

Fig. 3. Section of maxillary bone of *Diplodocus longus*, showing functional fourth tooth in position and five successional teeth in dental cavity; one half natural size. After Marsh.

The Vertebræ.

The skeleton of *Diplodocus* (No. 84) discovered by Dr. J. L. Wortman, in 1899, has the vertebral column especially well preserved, and will be used as the basis for the following description of that part of the skeleton. In this individual alone forty-one vertebræ were recovered, and they are believed to form an uninterrupted series extending from the axis to the twelfth caudal. This exceptionally well preserved series of vertebræ was unearthed with great skill and care during the season of 1899 under the immediate supervision of Dr. Wortman, assisted by Messrs. W. H. Reed and A. S. Coggeshall. The locality is designated as Quarry D, and is situated about one mile south of Sheep Creek in the lower Sheep Creek Basin, in Albany County, Wyoming. The horizon is the middle Atlantosaurus beds of Marsh (the Como stage of later authors). At this locality these beds attain a thickness of perhaps 300 feet, and are underlaid by the marine Baptonodon beds and are overlaid by the Dakota sandstones, with no apparent unconformities between the three series.

The surface in the immediate vicinity of the quarry is comparatively level, with a gentle, northerly slope. Most of the bones of the skeleton when discovered lay on

their right sides, so that this side is as a rule best preserved. The pelvis and caudal vertebræ were near the surface. The caudals were interrupted at the twelfth, which lay on the line of outcrop of the bone-bearing horizon. The succeeding caudals were missing, having been removed by surface erosion. From the twelfth caudal anteriorly the vertebral column extended into the gently sloping hillside, with, however, some displacements. Unfortunately no diagram of the quarry was made, at the time of exhuming the remains, showing the relative position of each of the several vertebræ and other bones as they lay imbedded in the rock. Early the following spring Mr. W. H. Reed, who assisted in taking up the skeleton, returned to the quarry and made for the writer a diagram showing the location of the various parts of the skeleton as he remembered them. This diagram has been submitted to Dr. Wortman, under whose supervision the skeleton was unearthed, and to Mr. A. S. Coggeshall, who also assisted Dr. Wortman in unearthing the remains. Both these gentlemen agree that it is essentially correct. It is reproduced in Pl. I., where it is included in the diagram of the entire quarry as worked out during the season of 1900 by Mr. O. A. Peterson and party. It occupies the central and lower portion of the plate and includes all those bones lying within the space bounded by the double full line and the broken line below, which latter marks the line of outcrop of the bone-bearing horizon in the quarry.

This diagram shows that while there were some displacements in the vertebræ, these were not so great or of such a nature as to preclude the possibility of their representing in so far as they go an uninterrupted series. On the other hand the different vertebræ did not lie in such relative positions as to make it certain that none were missing from the series.

Mr. A. S. Coggeshall, who assisted in unearthing the skeleton, contributes the following statement concerning its disinterment and the relative position of the different parts as they lay imbedded in the matrix. He says: "Work was carried on in both directions from the sacrum. Posteriorly the caudals extended in an almost continuous series to the twelfth, where the bone-bearing horizon emerged on the surface of the gently sloping plain. The animal had evidently fallen on his right side, and that being more deeply imbedded, was better preserved than the left. The ilia were in position, coössified with the sacrum, but the left ilium and a considerable portion of the sacral vertebræ were so near the surface as to have become badly disintegrated and in a hopeless condition. In front of the sacrum, with which the last dorsal was coössified, the last seven dorsals extended in a continuous series, more or less completely interlocked by their zygapophyses. The eighth and ninth presacrals were interlocked, but shifted somewhat from their natural position, and stood on

end, the ninth lying on top of the eighth. The tenth and eleventh were also interlocked. The twelfth presacral or last (fifteenth) cervical was considerably removed from the succeeding dorsals and less so from the preceding cervicals. Commencing with the next vertebra (cervical fourteen), the direction of the entire cervical series was altered so that it lay with its axis almost at right angles to that of the dorsal series. The cervicals extended in an almost straight line from the fourteenth to the fifth, but there was a considerable gap between cervicals eleven and ten, while the axis and cervicals three, four and five were doubled back under the succeeding vertebræ."

"Of the remainder of the skeleton the bones secured were found in the same relative positions as shown in the diagram (Pl. I.). Most of the ribs of the right side were not shifted far from their original position in reference to the vertebral column. The right femur was nearly in position, the left scapula and coracoid were shifted far forward from their normal position and lay parallel with the cervical series. The right pubis lay just in front of the ilium, parallel with the skeleton, with the proximal end toward the ilium, while the left pubis* was found near the tenth caudal and lay at right angles to the caudal series. The ischia lay side by side, mingled with the ribs in the mid-dorsal region, while not far distant were the two sternal plates."

Throughout the excavations attending the disinterment of the above-mentioned remains strong hopes were entertained that the entire skeleton would be recovered, save only the posterior caudals, which, if ever imbedded with the other remains, had evidently been entirely removed by recent surface erosion. Late in the autumn of 1899 the work of excavating for the still missing portions was abandoned for the season. During the latter part of April and first part of May, 1900, an additional excavation was made by the present writer and a considerable area uncovered lying immediately adjacent to that worked the previous season by Dr. Wortman. This resulted in the discovery of portions of a second skeleton of *Diplodocus*. Early in May the work of exhuming the remains of this second skeleton was entrusted to Mr. W. H. Reed, who continued the work uninterruptedly until May 27th, when Mr. O. A. Peterson took charge, making extensive additional excavations. He continued the work throughout most of the season of 1900, assisted by Mr. C. W. Gilmore and Mr. Wm. Patton. Notwithstanding the extensive excavations made in 1900 in search of the missing portions of the skeleton discovered and taken up by Dr. Wortman during the previous season, not a single bone was found in these subsequent excavations, which can be said without doubt to pertain to that skeleton.

General Characters of the Vertebral Column.

The Sauropoda have been considered as the least specialized of the Dinosauria, and in many respects this is doubtless true, but in its adaptation for the application of those mechanical principles which combine maximum strength with minimum weight and increased surface for muscular attachment, the vertebral column of *Diplodocus* exhibits a remarkable degree of specialization, unsurpassed if not unequaled by other vertebrates.

The centra throughout the entire series are invaded on either side by large lateral cavities (*pleurocentral cavities*), while the interior instead of consisting of solid bone is made up of numerous cavities enclosed by an intricate series of thin bony plates. These meet and cross at every conceivable angle and abut against the thin outer walls of the centra in such manner as to afford the greatest possible resistance to external strains.

The neural arches, neural spines, transverse processes, and zygapophyses are either constructed of or supported by laminæ, which come in contact with the respective parts in such manner as to give the greatest possible support with the least possible weight. The position and direction of these laminæ are so arranged in each vertebra as to afford the greatest resistance in the direction of the greatest strains and stresses which were brought to bear upon the various parts in the necessary movements during the life of the individual. By reason of this the position and direction of these laminæ are quite dissimilar in different parts of the vertebral column. Not only is any single vertebra unlike the preceding or succeeding one, but so variable are the positions of the several laminæ, buttresses, etc., that they frequently occupy quite different positions, on opposite sides of the same vertebra, sometimes resulting in a remarkable asymmetry. This asymmetry and the dissimilarity noticed in adjacent vertebræ of *Diplodocus* render it necessary to give a detailed description of each of the presacrals even at the risk of being tedious.

Before proceeding with the detailed description of the several vertebræ, it may be well to give a general description of the vertebral column as a whole.

By a glance at the accompanying restoration it will be seen that the sacrum is the central or nodal point in the vertebral column. Not only are the presacral and caudal regions subequal in length, but the individual vertebræ of the former are opisthocœlous, while those of the latter are procœlous. Moreover the long, coossified sacral spines are replaced anteriorly and posteriorly by the free simple spines of the adjacent dorsals and caudals, which, as we recede from the sacrum, rapidly become shorter and emarginate at the apex, resulting anteriorly in a pair of transversely placed neural spines widely separated above but converging below. These

paired spines commence with the sixth dorsal and are continued anteriorly in dorsals 5, 4, 3, 2 and 1, and in most of the cervicals.

General Description and Nomenclature of the Different Vertebral Elements.

A careful examination of any vertebra of *Diplodocus*, except it be a posterior caudal or anterior cervical, will show it to consist of a centrum, neural arch, neural spine, transverse processes, anterior and posterior zygapophyses, etc., or those elements usually met with in the vertebræ of the reptilia and higher vertebrata. In addition to these elements, there will be seen in the vertebræ of *Diplodocus* a number of prominent laminæ and buttresses which support the different processes and give origin to certain rather deep cavities that appear as conspicuous characters on the external surfaces of the vertebræ. Owing to the extreme variation in the size, shape and position, assumed by these laminæ and cavities in the different vertebræ, no little difficulty is encountered when a detailed description of the individual vertebræ is undertaken. This will be facilitated by first giving a careful description of those elements as they are exhibited in that part of the vertebral column where any particular lamina or cavity is best represented, and by the employment of a precise nomenclature for each. For those elements usually found in the vertebræ of all vertebrated animals, the usual and well-established nomenclature will of course be employed, while in referring to the different *laminæ* the excellent descriptive nomenclature proposed by Osborn will be used, expanding it in one or two instances to meet the further requirements made necessary by our present more perfect material. For the different *cavities* a nomenclature has been devised and will be employed which it is believed is both explanatory and precise and will prove to be a useful descriptive adjunct.

The Centra.—The centra throughout the entire extent of the vertebral column have expanded extremities separated by very pronounced median constrictions, so that each centrum is in form similar to that of an hour-glass. The centra are not solid, but are composed internally of intersecting laminæ arranged irregularly and abutting against and supporting the thin external walls. Externally and laterally each centrum is invaded by a pair of cavities, which may be called the *pleuro-central cavities*, while inferiorly there is, except in the dorsals and sacrals, a single median *infracentral cavity*. The centra of all the presacral vertebræ are opisthocœlous, while those of the postsacrals are procœlous. They increase in length from the axis to the fourteenth cervical, which is the longest in the vertebral column, and then gradually decrease in length to the third dorsal. Throughout the succeeding dorsals,

sacrals, and anterior caudals they remain subequal in length, increasing somewhat in the mid-caudal region, while the posterior caudals are elongated, rod-like bones without processes.

The Neural Arches.—Throughout the entire cervical series the neural arches are low. Commencing with the anterior dorsals they increase rapidly in height and give rise superiorly to the broadly expanded diapophysial elements of the transverse processes, which appear as quite prominent features throughout the entire dorsal series.

The Neural Spines.—These are either paired, as in the cervicals and anterior dorsals, where they are placed transversely, or single, as in the posterior dorsals, sacrals and caudals. There is no nodal vertebra separating the paired from the unpaired spines, but the latter are gradually derived from the former by the convergence of the paired spines.[7] This commences as a fusion in their inner and inferior margins, first noticed near the base of the spines of the second dorsal. This union becomes gradually more pronounced in the succeeding vertebræ until there is formed in the ninth dorsal a simple spine with emarginate extremity and finally results in the tenth and eleventh dorsals and sacrals in the production of a perfectly simple neural spine with no indication of division. The neural spines of the three true sacrals are firmly united into a single, powerful spinous process, which is the highest in the entire vertebral column. Posteriorly the division just noticed in the spines of the cervicals and anterior dorsals is partially imitated in the neural spines of the anterior caudals, but never results in anything more than an emargination of the extremities. This is most pronounced in the sixth caudal, where it attains a depth of some four or five inches. It rapidly becomes less distinct in the succeeding caudals and entirely disappears in the eleventh and posterior caudals. The sacral spines are the longest in the vertebral column. Anterior to the sacrum the spines gradually decrease in length and are directed upward and forward. Posterior to the sacrum the neural spines decrease more rapidly in length and are directed upward and backward.

The Transverse Processes.[8]—These are best developed on the posterior dorsals, where they spring from the point of union of the long neural spines with the neural arches, and terminate in widely expanded diapophyses. In this region the dia-

[7] It is more probable that the paired spines were derived from the simple by the gradual and increased emargination of the summits of the latter. Thus the simple spines should be considered the primitive and the paired the specialized conditions.

[8] There may be some question as to the exact homology of these processes. Osborn has referred to them both as metapophyses and as diapophyses or transverse processes. Considering their position in the anterior vertebræ I hardly think they can be other than homologous with the transverse processes of mammalian osteology.

pophyses and neural spines in their relations to each other have a certain resemblance to that of the yard-arms and masts of a ship. In the seven posterior dorsals the diapophyses are situated high above the centra, all approximately in the same plane. Commencing with the fourth dorsal and continuing anteriorly the diapophyses gradually become shorter and assume a less elevated position, until in the first dorsal the position is about on a level with the superior border of the centrum. This relative position is maintained throughout the cervical series. There are prominent rugosities developed near the extremities of the diapophyses. These are smaller and look upward in the posterior dorsals, but larger, and with their surfaces directed outward in the anterior dorsals. They doubtless served for muscular attachment.

The Zygapophyses.—The caudals and posterior dorsal vertebræ articulate by rather small and in the latter series much elevated zygapophyses. In the posterior dorsals the articular surfaces are small and continued into those characteristic compound articulations designated by Marsh as the *diplosphenal* and by Cope as the *hyposphenal* or *hyposphene-hypantrum* articulations.

In the anterior dorsals and in the cervicals the zygapophyses are lower, more expanded transversely, with greatly enlarged articular surfaces, which describe more or less accurately the arc of a circle, the anterior looking upward and inward and the posterior downward and outward.

Rib Facets.—Each dorsal vertebra in *Diplodocus* bears a rib, and in all but the last dorsal these ribs are movable and articulate with their respective vertebræ by two facets, a tubercular facet placed on the extremities of the diapophyses and a capitular facet situated anterior and inferior to the tubercular facet and placed either on the side of the neural arch, or of the centrum. The tubercular facets in dorsals five to ten inclusive occupy the extremities of the diapophyses. They look directly outward and during the life of the individual, when in its normal quadrupedal position, these facets, together with the zygapophyses of these vertebræ, lay in approximately the same plane, which was inclined slightly forward. Commencing with the fourth dorsal and in the preceding anterior dorsals the diapophyses rapidly assume a position inferior to that of the zygapophyses of their respective vertebræ, and their extremities are deflected so that in the third and fourth dorsals the tubercular facets look downward and outward. In dorsals one and two this deflection becomes very pronounced, is continued as an inferior extension of the diapophyses, and the tubercular facets look directly downward, so that in dorsal one they are on a line with the middle of the centrum.

Commencing with dorsal six and continuing throughout the succeeding dorsals the capitular facets all occupy the same plane, which is slightly inferior to that of

the tubercular facets. They are circular in outline, and occupy the extremities of short processes which spring from the sides of the anterior zygapophyses. Commencing with the fifth and continuing throughout the anterior dorsals, these facets are sessile and successively occupy less elevated positions. In the fifth dorsal the capitular facet is on the middle of the neural arch, while in dorsals four and three it has shifted down to the centrum and encroached upon the pleurocentral cavities of these vertebræ. In dorsals two and one it lies wholly inferior to that cavity, and in the latter vertebræ it is situated quite on the anterior and inferior margins of the centrum. In dorsals three, four, and five the capitular facet is much larger than in the preceding and succeeding dorsals, and instead of being circular is obovate in outline.

The Laminæ.—These form a rather complicated system of bony plates springing from the external surfaces of the vertebræ. They are quite effective as mechanical adaptations, affording greater strength and increased surface for muscular attachment with a minimum of weight. They are so arranged about the neural spines, diapophyses, transverse processes, and zygapophyses as to have afforded greatest support to those elements in those directions against which, during the life movements of the animal, there were exerted the greatest strains and stresses. The following nomenclature is in the main that of Osborn.

1. *Prespinal Laminæ.*—Rising from the union of the prezygapophyses and extending to summit of the median or single neural spines.[9]

2. *Postspinal Lamina.*—Rising from union of postzygapophysial and extending to summit of median or single neural spines.

3. *Horizontal Laminæ.*—Uniting the zygapophyses of opposite sides medially, and laterally connecting the prezygapophyses, diapophyses and postzygapophyses of the same side. These laminæ are divided by the diapophyses into anterior and posterior blades. These blades occupy the same horizontal plane in each of the posterior dorsals, but in the anterior dorsals and in the cervicals they are placed obliquely to the longer axis of the vertebræ, and instead of occupying the same plane, they meet in the diapophyses and form a widely open letter V.

4. *Prezygapophysial Lamina.*—Descending from anterior border of paired spines, or diverging from same border of single spines and usually passing through anterior zygapophyses, capitular facets to superior and anterior margin of centrum. Superiorly they are usually simple, but below the zygapophyses they may be divided into two or three blades as in the anterior dorsals and most cervicals.

[9] This and the next lamina are not present in the paired spines. The laminæ referred to by Osborn as present on those spines are the superior blades of the pre- and postzygapophysial laminæ, and not pre- and postspinal laminæ.

5. *Postzygapophysial Lamina.*—Descending from posterior border of paired spines, or diverging from middle of single spines and passing downward through postzygapophyses to form posterior border of neural arch. Simple or branched below postzygapophyses.

6. *Diapophysial Lamina.*—Best shown in seventh dorsal, where it rises from the side of the simple neural spine and descends vertically through the diapophyses and continues throughout about one-half the extent of the neural arch. This lamina is divided by the diapophysis into superior and inferior blades. The superior blade is suppressed in the anterior dorsals and in the cervicals.

7. *Pleurocentral Lamina.*—Present only in the median and posterior cervicals and anterior dorsals, where it rises upon the anterior and superior border of the centrum, extends downward and backward, crossing and dividing into two parts the large pleurocentral cavities.

8. *Oblique and Intersecting Laminæ.*—On the sides of the centra and neural arches, the latter usually supporting the zygapophyses.

The relative prominence and position of these various laminæ vary greatly in the different vertebræ. They are most constant in the posterior dorsals. In these vertebræ the *diapophysial* and *horizontal laminæ* meet at right angles and intersect one another at a point midway between the top of the neural spine and base of centrum and midway between the anterior and posterior zygapophyses. From this point of intersection spring the *tubercular* or *diapophysial* rib facets. Thus the transverse processes divide the diapophysial laminæ into inferior and superior branches and the horizontal laminæ into anterior and posterior branches. The anterior branch of the latter divides in the sixth and preceding dorsals and posterior cervicals into superior and inferior blades.

The Vertebral Cavities.

1. *The Diapophysial Cavities.*—The different branches of the horizontal and diapophysial laminæ radiate from the diapophyses in such manner as to form four large and subequal cavities, or pockets, left open externally. These four cavities, or pockets, are quite constant throughout the entire presacral series, and they are especially prominent in the anterior dorsals and posterior cervicals, where, from their position in regard to the diapophyses, they may be dominated respectively as the *infra-*, *supra-*, *post-* and *prediapophysial* cavities. In these vertebræ the *diapophysial* and *horizontal laminæ* have shifted from the perpendicular and horizontal planes they occupied in the postdorsals to oblique positions.

2. *The Zygapophysial Cavities.*—These are four in number and in regard to the position occupied by each with reference to the zygapophyses, they may be called the supra- and infra-, post- or prezygapophysial cavities. They appear as conspicuous features on all the presacrals save the anterior cervicals, where they are less pronounced.

3. *The Spinal Cavities.*—These are quite numerous and occur with more or less regularity as pockets in the surface of the single or paired spines. They are not unusually of considerable extent, as in the posterior dorsals, where they are formed and partially enclosed by the expansion of the free edges of the various laminæ that spring from the sides of such spines. Again they may be small and formed by the irregular development of secondary laminæ, or by inflections in the external walls of the spines.

4. *The Pleurocentral Cavities.*—These are constant throughout the entire vertebral column of *Diplodocus*, though varying greatly in the different regions in size, form and structure. As the name implies, they are located one on either side of each centrum, though, as frequently happens in the posterior cervicals and anterior dorsals, they may each be divided by pleuro-central laminæ into two or more partially distinct cavities. The pleuro-central cavities of opposite sides of the same vertebra are usually separated by a thin median partition, but occasionally this partition fails and they become confluent. This condition is met with more especially in the posterior cervicals.

5. *The Infracentral Cavities.*—Present on the inferior surface of cervicals and caudals. Absent in dorsals and sacrals.

6. *The Intramural Cavities.*—Present not only within the external walls of the centra, but within those of the neural spines, transverse processes, zygapophyses, neural arches, the different laminæ, etc.; thus these elements are reduced to a complicated system of delicate intersecting laminæ which enclose the *intramural cavities* and abut against and give support to the external walls. They thus form a second and exceedingly efficient method of combining strength and increased surface for muscular attachment with lightness.

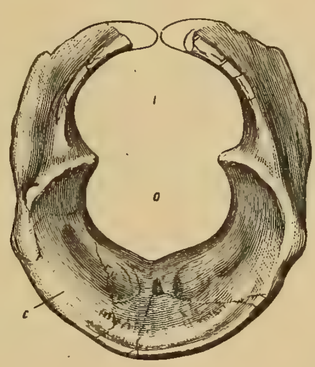
With this general description of the different vertebral elements we may proceed with a description of the individual vertebræ.

The Cervicals.—There are fourteen cervicals represented in our skeleton No. 84. These appear to constitute a complete series from the axis to the last cervical inclusive. The atlas would then be the only cervical vertebra missing from this series. So far as is known there is no atlas of *Diplodocus* in our collections. Marsh has published figures of the atlas which are reproduced here in Figs. 4 and 5. He nowhere

gives any description of this vertebra. His description of the entire vertebral column of *Diplodocus* in his "Dinosaurs of North America" is quite brief considering the highly interesting and remarkably specialized nature of this part of the skeleton. He dispenses with the vertebral column in two short paragraphs of eleven lines. From Marsh's figures the atlas appears to be rather short and very narrow, without expanded transverse processes. The neural spine is absent or very low, with a short anterior projection and a rather long posterior projection, with small posterior zygapophysial articular surfaces. There is a marked constriction between the neural canal and the cavity for the odontoid process. A small cervical rib is seen on the lower margin of either side of the posterior extremity.

The Axis.—The axis in this skeleton is quite complete and remarkably symmetrical for a vertebra of *Diplodocus*. The greatest length of the centrum is a little less

4.



5.

FIG. 4. Atlas of *Diplodocus longus;* side view; one half natural size. *a*, articular face for axis; *c*, cup; *r*, face for rib; *z*, posterior zygapophyses. After Marsh.

FIG. 5. Atlas of *Diplodocus longus;* front view; one half natural size; *c*, cup; *o*, cavity for odontoid process; *l*, neural canal. After Marsh.

than the distance from its ventral surface to the top of the neural spine. Prominent postzygapophysial laminæ spring from the posterior and superior border of the neural arch. These diverge and extend upward and backward until they reach the summits of the postzygapophyses, when they are directed suddenly forwards and rapidly converge, meeting anteriorly and superiorly in the middle line to form the prespinal lamina. They thus enclose a deep *postspinal cavity* which opens posteriorly and externally. The anterior zygapophyses are very small and low. They occupy expansions projecting from near the middle of the sides of the neural arch, do not project forward beyond its anterior border, and look directly upward. The posterior zygapophyses are much elevated and face outward, downward and back-

ward. There are prominent rugosities just above the postzygapophyses. There is a prominent transverse process springing from the middle of the sides of the neural arch. It is broad and thin and is directed downward, backward and outward, and terminates inferiorly in a small spatulate expansion. The posterior blade of the horizontal lamina extends from the transverse process to the posterior zygapophysis at an ascending angle of 45°. The inferior blade of the diapophysial lamina has a horizontal position and supports the posteriorly projected transverse process by forming a short laminar buttress connecting that process with the sides of the neural arch and separating the infradiapophysial cavity from the postdiapophysial cavity. This latter cavity is separated from the supradiapophysial cavity by the posterior blade of the horizontal lamina. There is no prediapophysial cavity in the axis. A short cervical rib without anterior process springs from the side of the centrum near its inferior margin and anterior extremity. Only the base of the odontoid process is preserved, but this indicates that it was of moderate length, with a slightly concave superior surface. The centrum is strongly opisthocœlous, as is the case also in all the succeeding cervicals and anterior dorsals. The central articulations of the cervicals and anterior dorsals of *Diplodocus* are the most finished of all the articular surfaces in the entire skeleton. There are deep pleuro-central cavities which extend anteriorly into the base of the odontoid process. Posteriorly these cavities are only separated from the cup for the ball of the succeeding vertebra by a thin plate of bone. Thus the body of the centrum is practically destroyed, and instead of consisting of a solid bony cylinder it is reduced to four thin plates. These unite to form the median longitudinal axis of the centrum. From this axis these plates diverge at right angles and partially enclose the neural canal and the infra- and pleuro-central cavities. At their anterior extremities they are united by a convex disc of bone, the ball or odontoid process; while at their posterior extremities they are united by the concave disc of bone which forms the cup for the reception of the ball of the succeeding cervical. With certain variations this structure prevails throughout the centra of all the cervicals. In this manner the inferior border of the cervical centra are concave both transversely and longitudinally instead of convex transversely and concave longitudinally as in the dorsals. The principal characters of the axis are well shown in Fig. 6.

FIG. 6. Axis of *Diplodocus carnegii;* seen from right side, one fifth natural size. From No. 84, Carnegie Museum collections.

Cervicals Three, Four, and Five.—All of these vertebræ are more or less injured.

The neural spines and transverse processes especially are not well preserved. Fortunately the centra, neural arches and zygapophyses are for the most part complete. These show that commencing with the third, the anterior zygapophyses are prolonged anteriorly beyond the ball of the centrum. There are also in each of these vertebræ, prediapophysial cavities. Owing to their imperfect condition in the region of the cervical ribs it is impossible to determine the nature of those elements in the vertebræ under consideration. In restoring these vertebræ the cervical ribs have been ignored and the vertebræ restored as if they were wanting in each instance. They were undoubtedly present, but it is impossible to determine whether the transverse and capitular processes were in contact and enclosed a lateral canal and whether or not there was an anterior branch of the cervical rib. The walls of the pleuro-central cavities become successively less regular in these vertebræ, and while consisting in C. 3 of a more or less flat and level floor of bone, in C. 4 and 5 the floors are invaded by several vacuities which open into intramural cavities enclosed within the outer walls of the centra. Commencing with C. 3 the neural spines of these vertebræ have been restored as bifid both anteriorly and posteriorly, each spine consisting of a broad thin plate of bone formed by the union of the pre- and postzygapophysial laminæ of their respective sides. These are made to appear free anteriorly and posteriorly, but united, except at their apices, throughout the inner sides; conditions which prevail in the succeeding cervicals.

Cervicals Six, Seven, Eight, Nine and Ten.—These vertebræ differ so little in their more important characters that they may be very conveniently described together. They are all fairly well preserved and show certain characters which are gradually more emphasized in the succeeding vertebræ of the series. Commencing with C. 6 they regularly increase in length posteriorly. The neural spines become more completely bifid, resulting in a pair of transversely placed perfectly free spines on the tenth cervical consisting of triangular plates of bone diverging superiorly and terminating at the summit in a rather blunt, rounded process. The walls of the centra in the pleurocentral cavities are successively interrupted by an increased number of vacuities and these cavities are more or less completely divided into anterior and posterior portions by strong bony plates (the pleuro-central laminæ), running from the base of the prezygapophyses obliquely downward and backward to the inferior border of each centrum. These are especially noticeable in cervicals nine and ten. Posteriorly the zygapophyses rapidly increase in size and the articular surfaces are successively more expanded, in order to gives a greater area to those surfaces of impact which were to resist the strains brought to bear upon them by the necessary movements of the neck and head during the life of the individual. As we proceed

posteriorly it will readily appear that the fulcrum formed by each anterior vertebral articulation would be subjected to successively greater strains during the process of elevation of the skull and that portion of the cervical series anterior to such vertebra. In order the better to resist these increased strains not only does the ball and socket of each vertebra successively increase in size, but the zygapophyses expand and the anterior ones, against which an increased proportion of the strain would be directed, are greatly reinforced inferiorly by the development of a second or even third inferior branch of the prezygapophysial laminæ (three in C. 10). These additional laminæ extend from the inferior surface of the broadly expanded prezygapophyses to the superior surface of the centrum, and are so arranged as to afford the greatest resistance possible to any force exerted from above. In C. 10 the median septum, which in the mid-central region in most of the cervical vertebræ alone separates the pleuro-central cavities, fails, and there is in this vertebra a large vacuity

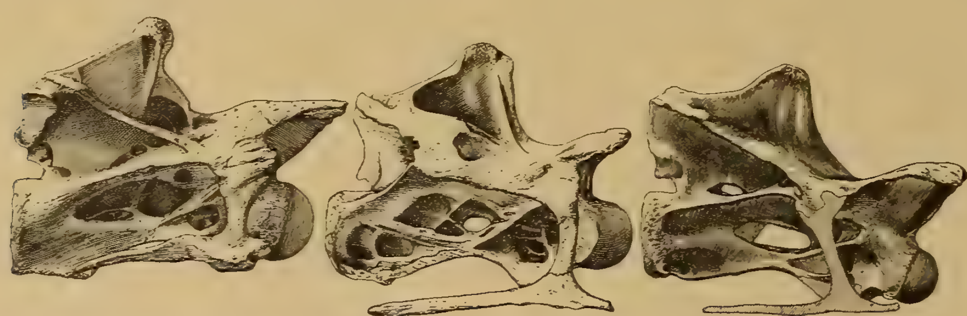


Fig. 7. Tenth, eleventh and twelfth cervicals of *Diplodocus carnegii*. Seen from right side; one fifteenth natural size. From No. 84, Carnegie Museum collections.

connecting these cavities. Near the lower and posterior borders of the postdiapophysial cavities there are in most of the vertebræ (absent in C. 9) rather prominent foramina. In C. 10 these form a vacuity situated above the neural canal and connecting the opposite cavities. The cervical ribs are prominent, bear anterior and posterior branches, and are connected with the transverse processes thus enclosing lateral foramina. Their position throughout the entire series is inferior to the centra.

Eleventh Cervical.—This vertebra is so unlike either the immediately preceding or succeeding vertebræ that if it had been found isolated it would have been unhesitatingly referred to a distinct genus. Mr. Coggeshall, however, assures me that it was interlocked with the succeeding, or twelfth cervical. The right side of this vertebra is very nearly perfect, the left was badly injured and the zygapophyses and left neural spine have been restored, not as they are shown on its right side, but as rep-

resented in the succeeding and preceding vertebræ.[10] A comparison of this vertebra with C. 10 and C. 12, as shown in Pl. III. and in Figs. 7 and 8 of the text, will reveal several striking differences. The zygapophyses are short and not so extended as the extremities of the centrum. The anterior and posterior blades of the horizontal laminæ are much reduced in length, and instead of uniting to form the transverse process they are widely separated and connected by a broad plate extending throughout one-half the length of the vertebra and overhanging the deep, pleuro-central cavity. The inferior blade of the diapophysial lamina is very short and extends obliquely forward and upward, meeting the descending posterior blade of the horizontal lamina at an acute angle just in front of the posterior border of the pleuro-central cavity, the two thus enclosing an exceedingly deep post-diapophysial cavity. About 65 mm. (2½ inches) in front of the junction of the horizontal and diapophysial laminæ there is a large vertebrarterial canal. This opens internally into the postdiapophysial cavity and externally on the outer surface of the broad plate connecting the anterior and posterior blades of the horizontal lamina. From the position of this foramen it may possibly be homologous with the vertebrarterial canal commonly found in the cervicals of the mammalia. It is quite wanting on all the other cervicals in *Diplodocus*. The posterior blade of the horizontal lamina in this vertebra sends backward a rather slender process some 75 mm. (3 inches) in length, parallel with the external border of the postzygapophyses, but separated from the latter by a deep, narrow groove. This groove, together with the vertebrarterial canal and the long, wide, deflected plate connecting the anterior and posterior blades of the horizontal laminæ are characters entirely wanting in the other cervical vertebræ of this series. The pleuro-central cavity occupies most of the side of the centrum. There is a vacuity in the mid-central region connecting the pleuro-central cavities of the opposite sides. The bottom of the pleuro-central cavity is otherwise interrupted by a complicated system of oblique and intersecting laminæ enclosing foramina leading to the intramural cavities. The infracentral cavity is very pronounced in this and the succeeding cervicals and the centra in these vertebræ are

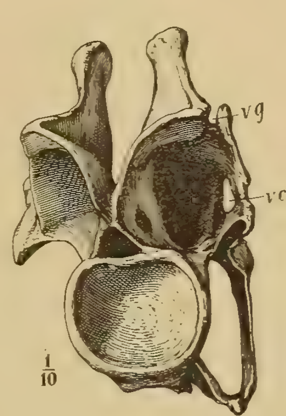


FIG. 8. Posterior view of eleventh cervical of *Diplodocus carnegii* (No. 84, Carnegie Museum collections), one tenth natural size. *v. c.*, vertebrarterial canal; *v. g.*, groove on external side of posterior zygapophyses.

[10] The work of freeing these vertebræ from the matrix and restoring them was for the most part done during my absence in the field. Unfortunately no drawings or photographs were taken prior to the process of restoring with colored plaster.

much constricted medially and expanded at their extremities. The zygapophyses are broad, with the articular surfaces transversely expanded, but contracted antero-posteriorly. The cervical rib is long and lies below the inferior border of the centrum. The combined length of the anterior and posterior costal processes are but little less than that of the centrum. The apices of the neural spines are both wanting in this vertebra. They have been restored as rather low and broad superiorly. In Fig. 7 are shown comparative views of this vertebra and cervicals 10 and 12, which immediately precede and succeed it.

The Twelfth Cervical.—This does not materially differ from the succeeding cervicals, but when seen from the side it contrasts strikingly with C. 11, as see Fig. 7, and Pl. III. There is no vertebrarterial canal. The bottom of the pleuro-central cavity is less complicated. It is invaded by four large vacuities. Three of these lie posterior and one anterior to the pleuro-central lamina, which in the vertebræ of this region starts from the anterior and superior border of the pleuro-central cavity and extends downward and backward to the middle of the inferior border of the centrum, thus dividing this cavity into an anterior and a posterior moiety. The diapophysial and posterior horizontal laminæ are long, occupying about two thirds the total length of the centrum. The post-diapophysial cavity is open externally throughout its entire length in marked contrast with the condition that obtains in C. 11. There is in this vertebra a striking instance of asymmetry. On either side of the neural arch and directly below the postzygapophyses there is in each of the preceding and succeeding cervicals of this region a pair of large foramina about one inch in diameter placed laterally and opening into the neural canal. In C. 12 this foramen is present and of normal dimensions on the right side, but on the left instead of opening into the neural canal it terminates in a shallow pit about three fourths of an inch in depth and completely closed with bone at the bottom.

The Thirteenth Cervical.—The pleuro-central cavity is more restricted posteriorly than in the preceding cervicals. The pleuro-central lamina is especially prominent and divides this cavity into a deep, rather small anterior and a somewhat larger posterior cavity. The anterior zygapophyses are overhanging and project beyond the ball of the centrum. They are each supported inferiorly, as in the other cervicals of this region, by two prominent inferior blades of the prezygapophysial laminæ which spring from the external and superior margins of the centrum just posterior to the ball and diverge to meet the zygapophyses superiorly. A third pair of branches, the internal of the prezygapophysial as also of the postzygapophysial laminæ, converge inferiorly, meet and intersect each other just above the middle of the neural canal, where they are exceedingly thin. Below the point of intersection

they diverge again to form the superior walls of the neural canal. In this manner anteriorly the left superior border of the neural canal is formed by the inferior extension of the right prezygapophysial lamina, and the right by the left, the inferior portions of these laminæ intersecting so as to form a letter X. Between the bifid neural spines there is a short spinous process homologous perhaps with the single spines of the posterior dorsals. This short median spine is present on the succeeding cervicals and anterior dorsals. Its presence in these vertebræ has led me to believe those laminæ defined by Osborn as the prespinal and postspinal laminæ of the bifid vertebræ to be homologous with the pre- and postzygapophysial laminæ of vertebræ with only one spine, and I have therefore called them by the latter names.

The Fourteenth Cervical.—This is the largest and slightly the longest vertebra in the entire vertebral series. The median constriction of the centrum is the most marked in the vertebral column. The pleuro-central cavities are deep, but entirely separated by a median septum. The anterior zygapophyses are supported inferiorly by two powerful laminæ. The postzygapophysial laminæ are large, and the prezygapophysial much reduced. Short median neural spine. Union of rib with centrum marked by suture. The transverse process is supported inferiorly and anteriorly by a prominent lamina which is directly opposed to the posterior blade of the horizontal lamina. This is the inferior of the two anterior blades of the horizontal lamina. It is present in the succeeding vertebræ and successively occupies a more horizontal position, gradually approximating that of the superior blade. In the sixth dorsal these blades are quite parallel, horizontal, and but little separated, while in D. 7 and 8 they are united throughout a portion of their length, and in D. 9 the union is complete and the anterior blade of the horizontal lamina is quite simple. See Plates III. and IV.

The Fifteenth Cervical.—The centrum of this vertebra is some two inches shorter than that of the preceding. The ball is marked by a pronounced median vertical groove also seen in the anterior dorsals. The superior of the anterior blades of the horizontal lamina has its external surface somewhat expanded and rugose. It no doubt served as a support for the muscular attachment of the heavy scapular arch. The suture for the capitular attachment of the rib is well marked. There is a distinct but short median neural spine between the two paired spines. The principal characters of the cervical vertebræ are well shown in Plates III., IV., V.

The Dorsal Vertebræ.

The dorsals are distinguished from the cervicals by supporting free instead of fixed ribs and in having the inferior surface of the centra regularly convex trans-

versely instead of concave in either direction as in the cervicals. Aside from these there are no sudden changes in the transition from cervicals to dorsals. The spines continue paired, the zygapophyses broadly expanded, while the centra are long in the anterior dorsals but rapidly shorten posteriorly. All the vertebræ between the last cervical and first sacral bear ribs, so that there are no lumbars in *Diplodocus*.

The First and Second Dorsals.—The superior branches of the anterior blades of the horizontal laminæ in these vertebræ are considerably modified in order to give a more substantial support for the suspension of the scapulæ. They are broadly expanded and inflected externally so as to present a broad, rugose external surface, much more continuous and prominent than that just described as obtaining in C. 15. The prezygapophyses in these vertebræ differ from those in the former by being supported inferiorly by a pair of *intersecting laminæ*. The paired spines are not so broad and are more acutely terminated than in the cervicals, and there is a short median spine. The pleuro-central cavities are deep and are not divided into two by the pleuro-central laminæ mentioned as present in the immediately preceding cervicals. The inferior blade of the diapophysial lamina is obliquely directed downward and backward, and opposes the modified superior branch of the anterior blade of the horizontal lamina, while the posterior blade of the latter is directly opposed to the inferior branch of its anterior blade. In this manner all these laminæ occupy oblique positions, but meet at right angles and enclose the pre-, post-, supra-, and infradiapophysial cavities. The latter in these vertebræ occupy their normal positions, which has suggested the names applied to them in this paper. The extremities of the transverse processes are continued into downwardly extended diapophyses terminating inferiorly in the tubercular rib facets. The capitular facets are small prominences seen on the anterior, inferior and external margins of the centra just behind the ball and below the anterior borders of the pleuro-central cavities. The two lateral laminæ projecting inferiorly and externally from the posterior portions of the cervical centra are wanting in these and the succeeding dorsals, and the inferior surface of that portion of the centra in these vertebræ is uniformly convex, there being no infracentral cavity. The superior arms of the X formed by the intersection of the inner of the inferior blades of the pre- and post-zygapophysial laminæ are much longer than the inferior arms. The pleuro-central cavity in D. 2 is the smallest of any in the presacral series in proportion to the size of the centrum. These increase in size both anteriorly and posteriorly from D. 2. There is an elongated pit placed vertically on the apices of the balls of these centra. The centra of these vertebræ rapidly become shorter, as will be seen by a refer-

ence to the measurements. The prezygapophyses extend beyond the anterior ends of the centra, while the posterior zygapophyses do not extend beyond the centra. See Plates VI. and VII.

The Third Dorsal.—Paired spines broad at base, but with pointed and widely separated extremities presenting elongated external rugosities. These spines, as those of the preceding dorsals and cervicals, are formed by the union of the superior blades of the post- and prezygapophysial laminæ. The latter in this vertebra function as the superior blades of the diapophysial laminæ, which are rudimentary in D. 4 and obsolete in D. 3. The post- and prezygapophyses are much elevated, as are also the transverse processes. The superior surfaces of these processes are almost on a line with the zygapophyses. Thus the anterior and posterior blades of the horizontal laminæ in this and the succeeding dorsals occupy approximately the same plane. There commences in this vertebra an approximation to the diplosphenal articulations which obtain in the posterior dorsals. The support for the postzygapophyses inferiorly is much modified. The inferior blades of the postzygapophysial laminæ instead of converging and intersecting, as in the succeeding vertebræ, are each divided into two branches, one vertical, the other horizontal. The former descend directly from the inner sides of the zygapophyses in sharp parallel laminæ to the outer walls of the neural canal; the latter converge and meet in the middle line a little below the zygapophyses, and form a long, very delicate, single median lamina, which descends, parallel to and midway between the vertical branches, to the superior border of the neural canal, where it again divides and sends off right and left laminæ to meet the inferior extremities of the vertical blades and form the superior border of the neural canal. In this manner these laminæ enclose and bisect longitudinally an oblong with concave extremities, thus , as shown in Pl. IV., Fig. 3. The transverse processes are widely expanded, with their extremities turned downward and backward and presenting two rugosities. The one larger and superior and external is evidently for muscular attachment. The other smaller and inferior and external is the capitular rib facet, and looks downward, outward and backward, instead of directly downward as in Ds. 1 and 2. The inferior blade of the diapophysial lamina is more perpendicular than in the preceding vertebræ, but is still quite oblique. The inferior branch of the anterior blade of the horizontal lamina is still widely separated from the superior branch. The anterior zygapophyses are supported inferiorly by very powerful laminæ, but the inferior blades of the secondary intersecting lamina are wanting. The pleuro-central cavity is deep and is invaded by the capitular facet, which is supported inferiorly by a short pleuro-central lamina which bisects the pleuro-central cavity. Centrum strongly opisthocœlous. The external wall is

broken away over a portion of the posterior end of the centrum, revealing the intramural laminæ. See Pl. VI., and Fig. 3, Pl. IV.

The Fourth Dorsal.—Centrum short, with strongly convex anterior and shallow concave posterior extremity. The latter is broadly expanded transversely and vertically. Laterally and inferiorly there is a deep median constriction extending into the pleuro-central cavities. These cavities are bisected by the short pleuro-central laminæ that support the large obovate capitular rib facets, which are borne about equally by the centrum and neural arches, but extend into the pleuro-central cavities. The neural arch is elevated. The transverse processes are widely expanded, broadly rugose distally and superiorly, and bear at their extremities the tubercular facets, which look more outward and less downward and backward than in the preceding vertebræ. Inferiorly the transverse process is supported by the inferior branch of the anterior blade of the horizontal lamina and by the perpendicular inferior blade of the diapophysial lamina, while on its upper side there is a rudiment of the superior blade of the latter lamina. Inferiorly the prezygapophyses are supported by a single lamina on the right side and a double one on the left. These extend from the inferior side of the zygapophyses to the superior surface of the capitular facet. The posterior zygapophyses are continued into the diplosphenal articulation so characteristic of the succeeding dorsals. These unite below to form a very sharp median lamina extending to the superior border of the neural canal. Posteriorly the transverse processes present broad, flat surfaces continuous with those of the posterior aspect of the neural arch. The extremities of the transverse processes show a rather deep posterior cavity overhung by the expanded superior rugosity. The paired spines are confluent for some distance above the superior surface of the posterior zygapophyses. They are styliform and present at their extremities rather elongated and expanded external rugosities. The median spine is less pronounced than in the preceding vertebra.

The Fifth Dorsal.—Centrum opisthocœlous, extremities widely expanded, deep median constriction, a low median ventral keel, pleuro-central cavities deep, only separated by a thin median lamina. Capitular facets obovate, very large, and borne on sides of neural arch. Neural arch much extended vertically. Zygapophyses not so broad as in preceding vertebræ, continued into the characteristic diplosphenal articulations, which are supported below by a thin median lamina posteriorly, and anteriorly by a much stronger but shorter lamina parallel with that which supports the prezygapophyses and like it confluent with the capitular facet. Widely extended and stout transverse processes, with broad, distal, superior rugosities, bearing at their extremities the rather large triangular tubercular rib facets. The latter are sup-

ported inferiorly and superiorly by the diapophysial laminæ which present posteriorly broad, flat and thin plates. Anteriorly and posteriorly the transverse process is supported by the horizontal lamina which in front has two branches. The bifid spines are confluent throughout one third their length. They are supported posteriorly by the postzygapophysial laminæ, and anteriorly by the prezygapophysial laminæ, which at the base of the spine are suddenly deflected and merged with the diapophysial laminæ. Median spine low, with distinct pre- and postspinal laminæ.

The Sixth Dorsal.—This differs from the preceding vertebræ in the more elevated and less expanded neural arch, in the bifid spines, which are confluent throughout two thirds their length, and in the more elevated position of the capitular rib facets. The emargination of the neural spines in this vertebra is 115 mm., or 4½ inches. For successive emargination of spines in dorsals compare figs. in Plate VII.

The Seventh, Eighth, Ninth and Tenth Dorsals.—The centra in these vertebræ are short, slightly opisthocœlous, with extremities expanded successively less constricted medially. Pleuro-central cavities, large and subequal, extending into base of neural arches. Neural arches much restricted laterally and antero-posteriorly, not wider than middle of centra. Capitular facets round and pedunculate, anterior and inferior to the small, circular, subequal, tubercular facets. The latter are borne at the extremities of the transverse processes which are more slender and somewhat less expanded than are those of the anterior dorsals, zygapophyses produced into the diplosphenal articulations. The postzygapophyses are each supported inferiorly by a narrow median lamina and by two diverging oblique laminæ. Anterior zygapophyses supported inferiorly by prezygapophysial laminæ and a very strong oblique lamina on sides of neural arches, which also give support to the capitular facets. Neural spines simple, but emarginate in 7, 8 and 9; entirely simple in 10. Strong post- and prespinal laminæ; from the external sides and near the bases of these spring the post- and prezygapophysial laminæ. Neural spines much expanded transversely by the expansion of the diapophysial laminæ, which superiorly are expanded into rather broad plates presenting extensive vertical external rugosities enclosing rather deep posterior and more shallow anterior spinous cavities. The former extend throughout the entire length of the neural spines. Horizontal laminæ with anterior blades bifid throughout half their length in dorsal seven, slightly bifid anteriorly in eight, and quite simple in nine and ten. See Plate VI.

The Eleventh Dorsal.—This, the last in the dorsal series, is greatly modified and functions as a sacral. It is coössified by the centrum with the true sacrals, but supports a free spine. There is no true sacral rib. The transverse process is rugose superiorly and is greatly expanded laterally and inferiorly into a broad, thin, dia-

pophysial lamina which abuts against and gives support to the anterior end of the ilium and sends off a rather delicate inferior branch which comes in contact with the lower border of the anterior blade of the ilium at its junction with the pubic peduncle. There is a large foramen between these two branches of the inferior diapophysial lamina and another and larger between the diapophyses and the inferior margin of the diapophysial lamina. There is a third and smaller foramen in the diapophysial lamina near its union with the neural arch. In addition to these foramina the cavity enclosed between the diapophysial laminæ of this and the first sacral is left widely open both superiorly and inferiorly. The centrum is broad and

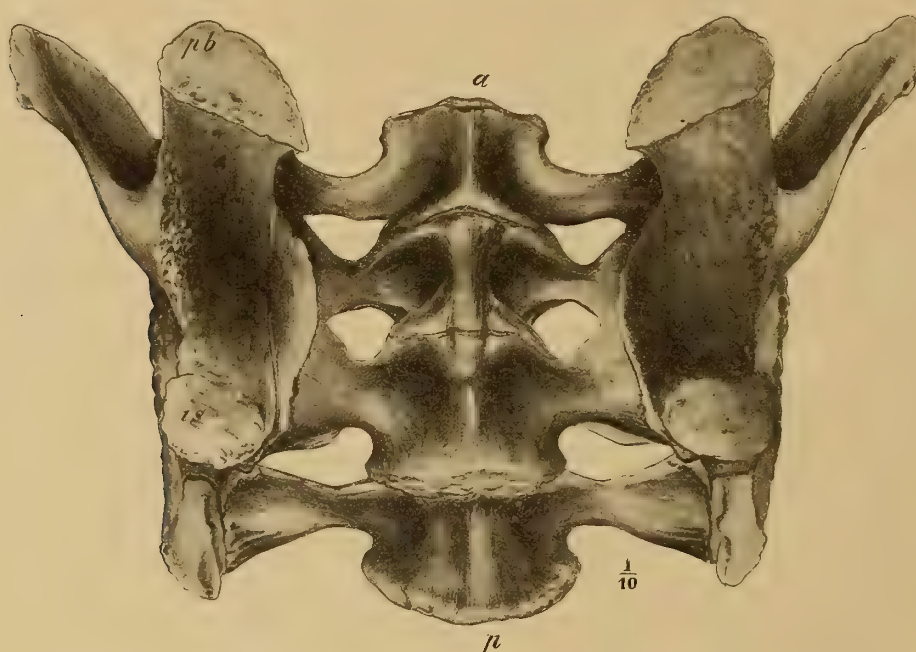


FIG. 9. Inferior view of sacrum and ilia of *Diplodocus carnegii* (No. 94), one tenth natural size; *pb*, pubic peduncle; *is*, ischiac peduncle; *a*, anterior end; *p*, posterior end.

short with pleuro-central cavity simple and of moderate depth. The zygapophyses are small and short. The articular surfaces are less extended than in any of the preceding dorsals. The neural spine is simple, very strong, and transversely expanded and rugose at the summit. There are exceedingly strong and rugose prespinal and postspinal laminæ. The superior blades of the diapophysial laminæ are well developed and have prominent superior rugosities. There was a small ossicle found between the spine of this vertebra and that of the first sacral. It is shown in position in the restoration.

The Sacrals.—The sacrum in *Diplodocus* may be regarded as composed of either

three, four, or five vertebræ according to the individual conception as to which should be considered as sacral vertebræ. If the sacrals are made to include all those vertebræ that, though formerly belonging to the posterior dorsals or anterior caudals, have laterally become so modified as to function as sacrals by affording support to the ilia either by bearing true sacral ribs or by means of greatly expanded transverse processes, or by both these methods, then the sacrum of *Diplodocus* must be considered as composed of five vertebræ. These are usually firmly coössified by their centra, though the centra of the posterior and anterior of these five vertebræ may occasionally remain free or only slightly coössified. The remaining three median vertebræ are always coössified by their centra and usually have their neural spines coalesced into one powerful spine, subequally expanded transversely and antero-posteriorly. These three median vertebræ constitute the sacrum of *Diplodocus* as understood and interpreted by the late Professor Marsh, who has described the sacrum as consisting of three vertebræ. Osborn, on the other hand, has included among the sacrals the posterior of the five modified vertebræ, while excluding the anterior chiefly because of the absence in it of a true sacral rib springing from the body of the centrum which he finds present on all the four succeeding sacral vertebræ. He therefore considers the sacrum of *Diplodocus* as consisting of four vertebræ, the three anterior of which he considers as having constituted the primitive Dinosaur sacrum, while the fourth has been added posteriorly by the modification of the anterior caudal. The two splendid sacra belonging with skeletons 84 and 94 in our collections are unusually complete and throw much light upon the structure and development of this element in Dinosaurs. In each instance the vertebræ are all firmly coössified with and give support to the ilia. In 84 the right ilium alone is preserved, and this is united to all five of the vertebræ which function as sacrals either by the means of true sacral ribs or the expanded diapophysial laminæ or by both these elements. All are coössified by their centra, and the three median have their neural spines coalesced. Thus in this skeleton it will be seen that the conditions found to obtain in the sacral region are very similar to those described by Osborn except that there is a rather greater modification of the last dorsal in the direction of that which obtains in the true sacrals than was noticed by the latter in his description. (Compare the description and figures given above with those of Osborn.) In skeleton 94, however, there are noticeable certain other more marked differences, which are worthy of especial notice as bearing directly upon the nature of the primitive Dinosaurian sacrum. In this skeleton the sacrum is present, with both ilia in position. The centra of the true sacrals are all coössified as in other sacrum. The neural spines of sacrals one and two coalesce and are co-

ossified throughout their entire length as in 84, but the spine of sacral three is quite free from, though closely applied inferiorly to, that of the second sacral. This would seem to indicate that the primitive Dinosaurian sacrum consisted of two rather than three vertebræ, a condition similar to that found in the Crocodilia and most other living Reptilia. The fourth sacral in No. 94 bears a free spine and is coössified by its centrum with the third and does not differ in any essential respect from that described by Osborn or from that which has been found to obtain in No. 84 of our collections. From the characters noticed above we may draw the following conclusions.

First.—That the primitive Dinosaurian sacrum consisted of not more than two vertebræ.

Second.—That in *Diplodocus* this primitive number of sacrals has been increased to four by the successive modification of anterior caudals resulting in the presence of three true sacrals with usually anchylosed spines and a fourth less completely modified sacrocaudal supporting a perfectly free neural spine.

Third.—That anterior to the true sacrals the last dorsal has been less modified than the anterior caudals, but so changed as to function as a sacral vertebra analogous to the so-called *pelvic vertebra* in *Struthio.*

The First, Second and Third, or True Sacrals.—As has already been noticed, these have centra not only coössified with one another, but usually with those of the immediately preceding and succeeding vertebræ also. The neural spines of sacrals one and two are always coalesced with each other and usually with that of the third. The centra increase in size posteriorly. Laterally they each support a pair of sacral ribs which expand and coalesce distally to form a broad, thick plate of bone coextensive with and closely applied to the acetabular portion of the ilium with which it is united by suture. This forms a considerable portion of the inner and superior portion of the acetabulum, as will be seen by a reference to Figs. 9 and 10. These vertebræ are further united with the ilia through their diapophysial laminæ, the inferior blades of which are greatly expanded and unite inferiorly with the sacral ribs and externally with the plates and crests of the ilia. They thus enclose on either side two large sacral cavities which open inferiorly and superiorly. The diapophysial laminæ in the sacral vertebræ divide into two blades near the base of the neural spines, one anterior, the other posterior. These blades diverge in such manner that the anterior blade of any vertebra abuts against, and coalesces with, the posterior blade of the diapophysial lamina of the immediately preceding vertebra. Thus the transverse process, as well as the inferior blade of each diapophysial lamina

in the sacrals, has its origin from two instead of one vertebra as in the dorsals and cervicals. The diapophysial process supported by the first and second sacrals is much stronger than those of the succeeding sacrals. The pleuro-central cavities are rather deep and the centra are much constricted inferiorly and medially. Between the summits of the spines of the first sacral and last dorsal there is a small bone

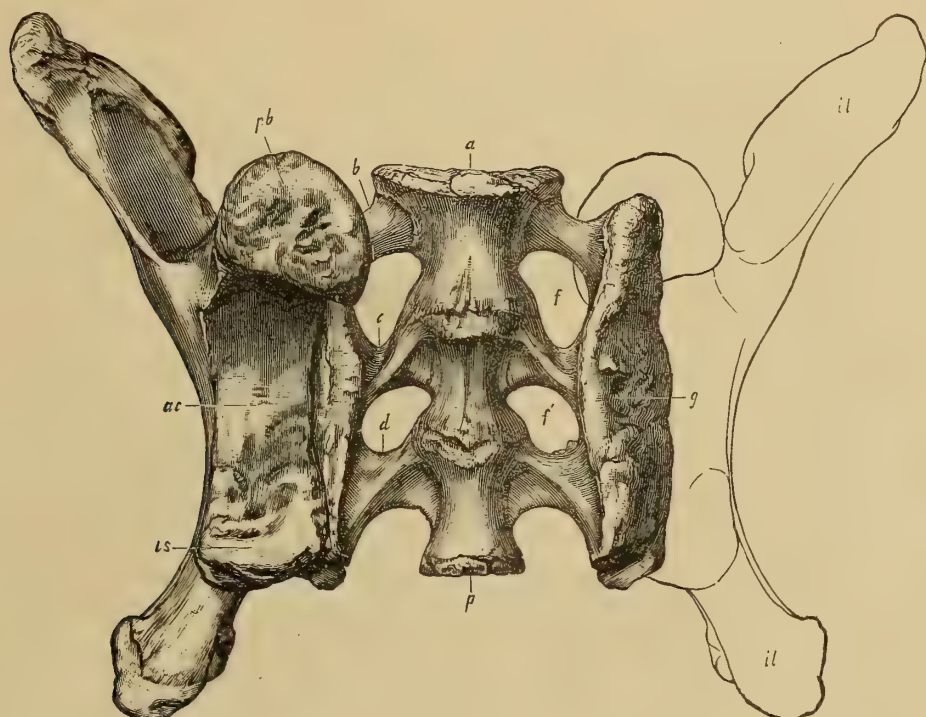


FIG. 10. Sacrum and ilium of *Diplodocus longus* Marsh; seen from below. With anterior and posterior ends of sacrum reversed. *pb*, pubic process; *is*, ischiac process; *ac*, acetabulum; *b*, *c*, *d*, sacral ribs; *f*, *f'*, foramina. One tenth natural size. After Marsh.

with very rugose surface. This was present in No. 84 and in the American Museum skeleton.

The Fourth Sacral.—Pleuro-central cavities not so deep and centrum less constricted inferiorly than in the three preceding true sacrals. Rather long and strong sacral ribs spring from either side of the centrum and unite by suture with the posterior blades of the ilia. They do not coalesce with the sacral ribs of the true sacrals nor do they come in contact with the neck of the ilia in such manner as to take part in forming the acetabulum. The neural spine is free and there is a broad diapophysial process formed as in the true sacrals by the union of branches from the superior blade of the diapophysial lamina of this and the preceding vertebræ.

The inferior blade of the diapophysial lamina has an extensive union with the crest and posterior margin of the ilium. It encloses posteriorly a third and larger sacral cavity which, like the two enclosed by the true sacrals, is left open superiorly and inferiorly.

In Fig. 9 is shown an inferior view of the sacrum and ilia found with skeleton 94. In this skeleton all the pelvic elements are complete, including the ilia, ischia and pubes. The sacrum is also complete save the first sacral, which is represented only by the centrum and sacral ribs. These are well preserved, but the neural spine, neural arch and diapophysial laminæ of this vertebra are for the most part wanting. The pelvic vertebra is entirely missing, having evidently become detached and removed from its normal position prior to the imbedding of the bones in the matrix. The fact that this vertebra could have been detached and separated with so little injury to the adjacent pelvic bones is in itself evidence of the imperfect union between it and those bones through the medium of the centrum and of sacral ribs. A comparison of Fig. 9 with that given by Marsh of the pelvis of *Diplodocus* in his "Dinosaurs of North America," and reproduced here in Fig. 10, will show that while that author was right in considering three as the number of true sacrals in *Diplodocus,* he mistook the anterior for the posterior end of the sacrum, since our material abundantly proves that the posterior sacral is the larger and the anterior the smaller of the series, instead of *vice versa* as Marsh supposed. The apparent similarity in the sacral ribs of these vertebræ in the two figures is due to the altered view necessitated in the adjustment of the posterior end of the sacrum to the anterior end of the ilium in the figure given by Marsh. His material having been found isolated it was quite natural for Marsh to assume that the sacral with the larger centrum was the anterior, but the reverse has proved to be the case. In Plate IX. may be seen posterior and lateral views of the pelvis of No. 84 and a side view of a pelvis of *Brontosaurus* for comparison.

The Caudals.—As in a previous paper, Osborn's interpretation of the sacrals will be accepted also in this paper. The number of sacrals is thus here placed at four, while the caudals begin with the first vertebra posterior to that modified as a sacral. The twelve anterior caudals are represented and for the most part are in an excellent state of preservation in No. 84, while associated with No. 94 there were found between twenty and thirty other caudals and several chevrons. These were for the most part found disarticulated, and they doubtless pertain to two or more individuals. The excellent caudal series belonging to the American Museum of Natural History furnishes much the most trustworthy evidence regarding the number, nature and structure of the caudals in *Diplodocus.* After a careful study of this

series Professor Osborn has estimated the number of caudals at 37. This number will more than likely be increased by future discoveries through the addition of a number of rod-like posterior caudals now known to obtain in the tails of certain other Dinosaurs. The caudal series in *Diplodocus* is in length about equal to that of the presacral series. The anterior caudals are short and subequal in length, while posteriorly they are somewhat more elongated. The inferior blades of the diapophysial laminæ are broadly expanded in the anterior caudals and terminate externally and superiorly in broad rugosities. These gave great surface for the attachment of the powerful dorsocaudal musculature which in life must have obtained in this region of the vertebral column and which served to facilitate both the movements of the tail and the alteration of the anterior portion of the body from the usual horizontal or quadrupedal position to the more erect bipedal or tripodal position which was perhaps less frequently assumed during the life of the individual. The centra are invaded throughout by very deep infracentral cavities, while the pleuro-central cavities are especially pronounced in the anterior caudals. All the caudal centra are somewhat procœlous in contrast with the opisthocœlous centra of the presacrals. The centra of all the caudals are constricted medially. The neural arches are low and in the anterior caudals they are invaded by a complicated system of cavities which extend down upon the superior border of the centra. Some of these cavities are continued as foramina leading to the neural canal. Such doubtless served for the transmission of nerves. Commencing with the fourth caudal the diapophysial laminæ of this and the succeeding caudals are perforated by a number of vacuities. These become elliptical in caudals five to eleven and the inner portion of the inferior blades of the diapophysial laminæ in these vertebræ are thus reduced to a number of parallel bars, as shown in Pl. X. In all the anterior caudals except the first the broad inferior diapophysial laminæ are strongly bent forward over the very deep and broad prediapophysial cavities. The postdiapophysial cavities are usually reduced to one or two rather large foramina just behind and at the base of the diapophysial laminæ. These lead either into the neural canal or the intramural cavities of the centra or neural arches. The infradiapophysial cavities are wanting, and the supradiapophysial, though present, are much reduced in size. The horizontal laminæ are short and their anterior and posterior blades unite to form the broad inferior blade of the diapophysial. The superior branch of the latter is wanting. The pre- and postspinal and the pre- and postzygapophysial laminæ are all present and well developed. The latter is continued superiorly and instead of merging with the median postspinal lamina as in the dorsals, about midway up the spine it assumes a lateral position and is continued superiorly into an extensive,

rugose, laterally expanded lamina probably homologous with the superior portion of the superior blade of the diapophysial lamina of the dorsals. The zygapophyses are small and have their anterior articular surfaces looking upward and inward, while the posterior look downward and outward. The neural spines are simple, directed upward and backward, and decrease in length rather rapidly, but gradually, as we proceed posteriorly. The anterior spines are emarginate at the summit, and this emargination is gradually accentuated, resulting in a cleft some five inches in depth at the summit of the spine of the sixth caudal. Posteriorly to the sixth this emargination becomes successively less pronounced and the spines of the tenth and succeeding caudals terminate in rounded, somewhat expanded club-like rugosities. All the caudal spines show numerous well-marked spinous cavities. In Nos. 84 and 94 of our collections the caudal spines point more decidedly backward than they are figured in Osborn's paper. Caudals two and three of No. 84 are coössified (pathologically) by their centra. In No. 94 caudals seventeen and eighteen (?) are similarly united, as shown in Fig. 11. The principal vertebral characters mentioned above are shown in Pls. III., IV., V., VI., VII., VIII., and IX., and in the various text figures.

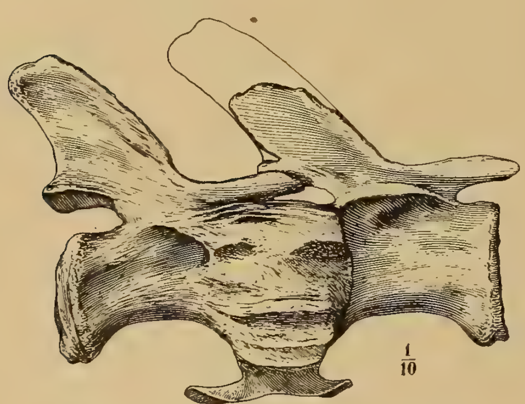


Fig. 11. Coössified caudal vertebræ of *Diplodocus carnegii*, with chevron coössified. About the 17th and 18th of No. 84. Seen from the right side. One tenth natural size.

The Chevrons.—Commencing with the second all the caudals bear intervertebral chevrons except perhaps the small posterior ones where they are probably wanting. It was in reference to the peculiar shape of the posterior chevrons that Professor Marsh proposed the name of *Diplodocus* (*double raftered*) for these animals. Marsh, however, erroneously supposed all the chevrons borne by *Diplodocus* to belong to this double-branched variety. We owe to Osborn the first description of the varied forms assumed by the individual chevrons throughout the different caudal regions of *Diplodocus.* From Cs. 2 to 6 inclusive the chevrons are nearly straight, completely surround the hæmal canal, below which the two arms are united into a long, straight and laterally compressed spine. From C. 6 to C. 11 inclusive the chevrons are less completely coalesced below the hæmal canal, and they are curved backward and resemble somewhat the blade of a sickle. Commencing with C. 13 the chevrons of this and the succeeding vertebræ assume the form described by Marsh and instead

of terminating below the hæmal canal in a single compressed spine, as in the chevrons of the anterior caudals, these spines are expanded and present anterior and posterior branches. The posterior branches are at first the longer of the two, but they soon become subequal in length. According to Osborn all the chevrons posterior to the thirteenth caudal are open above the hæmal canal. The anterior and posterior branches of the anterior branched chevrons surround a long median opening which is confluent with the hæmal canal. While in this region the inferior branches of the chevrons are coalesced at their extremities, posteriorly they are reduced to long slender rods closely applied to, but entirely separate from one another throughout their entire length. Each chevron is united more closely to the posterior of the two vertebræ with which it comes in contact than with the anterior. According to Osborn the sixteenth chevron is firmly coalesced with the centra of the eighteenth caudal in the American Museum skeleton, and among the caudals found with No. 94 in our collections there is one also bearing a coössified chevron which compares well in size and form with the eighteenth in Osborn's series. This would seem to indicate that this is a constant feature. Moreover this is just that region of the caudal series which would come in contact with the ground when in life this animal assumed a tripodal position. It is to this end no doubt that the chevrons of this region have been so modified and their union with the caudals made more complete in order the better to resist the impact brought to bear at this point by the superimposed weight of the tail and body, more especially when the animal assumed a tripodal position.

The Vertebral Formula.—From the above description it will be seen that the vertebral column of *Diplodocus* contains about seventy vertebræ. The following formula indicates the number of these belonging to the different regions as indicated by the material at present available for study, viz., cervicals 15, dorsals 11, sacrals 4, caudals 35 to 40 or even more. While these figures cannot be taken as absolutely correct, they cannot be far wrong. Whatever change either in the absolute number of vertebræ in any single region, or of the vertebral column as a whole, may be necessitated by the future discovery of more perfect material, we may be perfectly sure that the relative proportions of the several regions as now understood will not be materially changed. *There can be no doubt that the pre- and postsacral regions were subequal; that the centrum was the center of power and nodal point in the vertebral column; that there were no true lumbars; that the dorsals were for the most part short and few in number, resulting in an abbreviated dorsal region; that the cervicals were elongated and more numerous than the dorsals, resulting in an elongated cervical region.* The elongated and increased number of cervicals, shortened and reduced

number of dorsals, absence of lumbars, rigidly coössified sacrals, are all characters found to be remarkably constant in birds, more especially in *Struthio* and other Ratites. They are, however, doubtless adaptive rather than genetic and are certainly indicative of no very close relationship. The one represents a condition found in highly specialized sauropod Dinosaurs, the other in comparatively generalized struthious birds. The two groups may have been derived from a common ancestral stem, or the former have given origin to the latter, but the very similar vertebral characters just noticed have without doubt been independently developed in either instance. The long tail of *Diplodocus* is essentially reptilian and contrasts strongly with that region of the vertebral series in recent birds, and is hardly approximated even by *Archæopteryx* among fossil birds.

The principal dimensions of the several vertebræ in *Diplodocus* skeleton No. 84 are given in the following table: In column 1 the greatest expanse of the transverse

	1		2		3		4	
	mm.	in.	mm.	in.	mm.	in.	mm.	in.
1 cervical.								
2 "			165	$6\frac{1}{2}$	54	$2\frac{1}{16}$	171	$6\frac{3}{4}$
3 "			243	$9\frac{1}{2}$	69	$2\frac{3}{4}$	200	$7\frac{7}{8}$
4 "			289	$11\frac{3}{8}$	81	$3\frac{1}{8}$	210	$8\frac{1}{4}$
5 "			372	15	94	$3\frac{5}{8}$	234	$9\frac{3}{8}$
6 "			442	$17\frac{3}{8}$	99	4	281	11
7 "			485	19	114	$4\frac{1}{2}$	323	$12\frac{3}{4}$
8 "			512	$20\frac{1}{8}$	120	$4\frac{3}{4}$	344	$13\frac{1}{2}$
9 "			525	$20\frac{5}{8}$	159	$6\frac{1}{4}$	375	$14\frac{3}{4}$
10 "			595	$23\frac{3}{8}$	175	$6\frac{7}{8}$	383	15
11 "			605	$23\frac{7}{8}$	210	$8\frac{1}{4}$	392	$15\frac{3}{8}$
12 "			627	$24\frac{5}{8}$	225	$8\frac{7}{8}$	433	17
13 "			638	$25\frac{1}{8}$	231	$9\frac{1}{8}$	495	$18\frac{5}{8}$
14 "			642	$25\frac{1}{4}$	295	$11\frac{5}{8}$	529	$20\frac{3}{4}$
15 "			595	$23\frac{3}{8}$	245	$9\frac{5}{8}$	542	$21\frac{1}{4}$
1 dorsal.			510	$20\frac{1}{16}$	255	10	614	$24\frac{1}{8}$
2 "	534	21	416	$16\frac{3}{8}$	233	$9\frac{1}{8}$	691	$27\frac{1}{4}$
3 "	724	$28\frac{1}{2}$	326	$12\frac{7}{8}$	311	$12\frac{1}{4}$	722	$28\frac{3}{8}$
4 "	722	$28\frac{3}{8}$	318	$12\frac{1}{2}$	343	$13\frac{1}{2}$	718	$28\frac{1}{4}$
5 "	650	$25\frac{5}{8}$	255	10	300	$11\frac{7}{8}$	781	$30\frac{3}{4}$
6 "	653	$25\frac{3}{4}$	255	10	280	11	793	$31\frac{1}{4}$
7 "	618	$24\frac{1}{4}$	264	$10\frac{3}{8}$	280	11	810	$31\frac{7}{8}$
8 "	595	$23\frac{3}{8}$	275	$10\frac{7}{8}$	309	$12\frac{1}{8}$	847	$32\frac{3}{8}$
9 "	552	$21\frac{3}{4}$	290	$11\frac{1}{2}$	288	$11\frac{5}{16}$	946	$37\frac{1}{4}$
10 "	585	23	267	$10\frac{1}{2}$	313	$12\frac{1}{4}$	966	38
11 "	530	$20\frac{3}{4}$	270	$10\frac{5}{8}$	321	$12\frac{5}{8}$	1051	$41\frac{3}{8}$
1 caudal.	710	$27\frac{7}{8}$	183	$7\frac{1}{8}$	334	$13\frac{1}{8}$	1049	$41\frac{1}{4}$
2 "	634	$24\frac{7}{8}$					995	$39\frac{1}{8}$
3 "	660	26			332	$13\frac{1}{16}$	897	$35\frac{1}{4}$
4 "	590	$23\frac{3}{16}$	250	$9\frac{3}{4}$	330	13	830	$32\frac{3}{4}$
5 "	533	$20\frac{15}{16}$	250	$9\frac{3}{4}$	325	$12\frac{3}{4}$	777	$30\frac{9}{16}$
6 "	527	$20\frac{3}{4}$	237	$9\frac{3}{8}$	309	$12\frac{1}{8}$	744	$29\frac{1}{4}$
7 "	553	$21\frac{3}{4}$	237	$9\frac{3}{8}$	317	$12\frac{1}{2}$	690	$27\frac{1}{8}$
8 "	519	$20\frac{3}{8}$	246	$9\frac{11}{16}$	309	$12\frac{1}{8}$	675	$26\frac{1}{2}$
9 "	502	$19\frac{3}{4}$	270	$10\frac{5}{8}$	300	$11\frac{13}{16}$	651	$25\frac{5}{8}$
10 "	442	$17\frac{3}{8}$	269	$10\frac{1}{2}$	295	$11\frac{5}{8}$	610	24
11 "	377	$14\frac{7}{8}$	269	$10\frac{1}{2}$	285	$11\frac{1}{4}$	610	24
12 "	295	$11\frac{9}{16}$	295	$11\frac{9}{16}$	272	$10\frac{11}{16}$	576	$22\frac{5}{8}$

processes are given, column 2 greatest length of centra, column 3 diameter of centra at posterior extremity, 4 height of neural spines above middle of inferior border of centra in presacrals and above inferior border of posterior end in presacrals.

Measurement of Ilium and Sacrum, No. 84.

Greatest length of ilium	1089 mm.	$42\frac{7}{8}$ in.
Length of five coössified centra	765 "	$30\frac{1}{16}$ "
Height of coalesced spines	1092 "	43 "
Fore and aft diameter of three coalesced spines at the summit	170 "	$6\frac{5}{8}$ "
Height of coalesced spines above superior acetabular border	970 "	$38\frac{1}{4}$ "
Distance from top of iliac crest to extremity of pubic peduncle	787 "	31 "

When adjusted to each other and placed in a straight line the forty-one vertebræ belonging with skeleton 84 form a series forty-three feet in length. Of this distance the fourteen cervicals measure 21 ft. 4 in., the eleven dorsals 10 ft. 8 in., the sacrals 1 ft. 9 in., and the twelve caudals the remaining 9 ft. 3 in. Add to this combined length of forty-three feet two feet for the skull and atlas and 23 ft. for the difference between 9 ft., the length of the twelve anterior caudals, and 32 ft., the total length of the caudal series as estimated by Osborn from their quite complete caudal series, and we shall have a total length of 68 ft. for the vertebral column and skull of this skeleton of *Diplodocus.*

The Neural Canal.

The neural canal is exceedingly small throughout the entire vertebral column when compared with the enormous bulk of the animal. Except in the sacrals where it is considerably enlarged, it nowhere has a diameter of more than two inches, hardly greater than that of the neural canal of a modern Rhinoceros. The small neural canal, together with the small skull and very small brain cavity of the latter are indicative of an extremely primitive nervous system and show that *Diplodocus* was a creature of but little mental or physical activity, sluggish in its movements, and but ill adapted to successfully compete with its contemporaries in a struggle for existence amid changing environments, especially when such changes were in any manner unfavorable to its existence.

The Sternum.—Associated with skeleton No. 84 were two somewhat irregularly shaped bones closely resembling in shape and size those figured and described by Marsh as the sternals of *Brontosaurus.* Marsh does not describe the sternals of *Diplodocus* except to say that "they are large and resemble those of *Brontosaurus excelsus.*" These bones are somewhat ovate in outline, with the narrower extremity much thickened and rugose, while at the opposite end they expand into broad, thin

plates. They are regularly but very gently concave superiorly and convex inferiorly. Contrary to Marsh I have interpreted the thick, narrow, rugose extremities of these bones as the posterior and the thin, broadly expanded extremities as the anterior. I believe these bones to have been closely applied and firmly united by cartilage throughout three fourths of their total length as indicated by the long, straight, rugose margin which extends from the thickened extremity throughout three fourths the total length of the bone and which I have interpreted as the inner margin of each sternal. The outer margin of each sternal is then slightly emarginate, thin and smooth, while anteriorly they are broadly pointed and rugose. Thus the sternum of *Diplodocus* may be considered as composed of two broad plates of bone arranged one on either side of the median line, with their longer axes parallel with the longitudinal axis of the skeleton. These bones were firmly united by cartilage throughout three fourths of their length. They are contracted and thickened posteriorly where they present a broad rugose surface for the attachment of the cartilaginous xiphisternum and sternal ribs. Anteriorly they expand into broad thin plates with rugose anterior margins by means of which they were attached to the coracoids and thus with the scapular arch possibly without the intervention of ossified clavicles or interclavicles. Taken together the sternals of *Diplodocus* would thus form a shallow, raft-like sternum, the individual elements of which have a certain resemblance to those found in Iguana, in which animal, however, they are separated throughout a considerable portion of their length by the interclavicle and are contracted both anteriorly and posteriorly. The connection between the ribs and sternum was chiefly posterior and not lateral as in the Ratitæ, and doubtless took place through well-developed cartilaginous or imperfectly ossified sternal ribs and xiphisterni. In Fig. 12 the sternal bones are shown in their relative positions to one another as here interpreted.

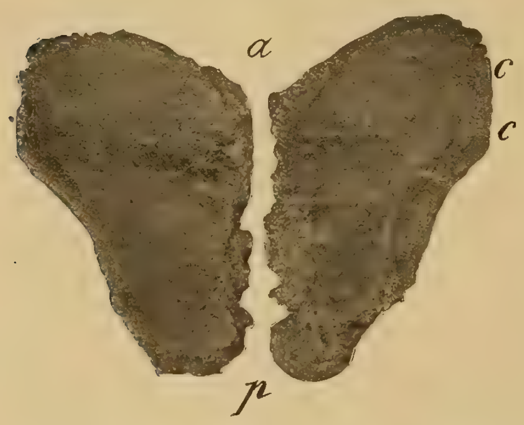


FIG. 12. Superior view of pair of sternal bones of *Diplodocus carnegii* (No. 84). *a*, anterior ends; *p*, posterior ends; *c*, *c*, surface for attachment of coracoids. About one eleventh natural size.

[11] Marsh places the narrow thick ends of these bones as anterior in *Brontosaurus*, while in *Morosaurus* he considers the narrow extremities as posterior. I believe the latter the correct interpretation, since it does not appear possible that the coracoids could have approached sufficiently close to one another to have articulated with the narrow thickened extremities which seem so well adapted for the support of the sternal ribs and xiphisterni.

Measurements of the Sternals.

Greatest length	$21\frac{3}{4}$ in.	553 mm.
" breadth	$13\frac{3}{8}$ "	340 "
" thickness	$3\frac{1}{2}$ "	89 "

The Clavicles.

Thus far no clavicles have been found in the Dinosauria. Since the Lacertilia are known to possess clavicles it is not unreasonable to suppose that these bones were present in at least some genera of the Dinosauria. Associated with the skeleton of No. 84 there was found a peculiar bone which from its general form and size might very well have functioned as a clavicle. This bone is 485 mm. ($19\frac{1}{8}$ in.) in length. Throughout the greater portion of its length it is almost circular in cross section and about 45 mm. in diameter. It is bifid at one extremity and slightly expanded and somewhat flattened at the other. It is strongly curved, especially toward the bifid extremity. It is asymmetrical. If this bone is not a clavicle it is difficult to assign it any other position in this skeleton. It evidently is not a rib, and from its size and shape it could very well have been a clavicle; moreover its position in the quarry, between the sternals and coracoids, would seem to afford additional evidence for assigning it such a position in the skeleton. Two views of it are shown in Fig. 13, *a*, *b*. If a clavicle, the convex surface was evidently the external, while the strongly inflected, bifid extremity would seem to have been the inferior and the broad, spatulate extremity the superior. We must, however, await future discoveries to determine definitely the nature and position of this bone; though I am at present strongly inclined to the opinion that it was a clavicle.

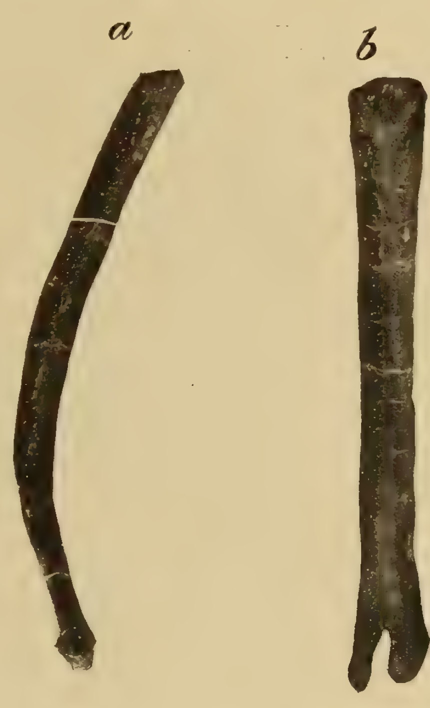


Fig. 13. Supposed clavicle of *Diplodocus carnegii* (No. 84); *a*, front view; *b*, external view. A little less than one sixth natural size.

The Ribs.

The cervical and sacral ribs and the fixed ribs of the eleventh dorsal have been described in connection with their respective vertebræ and need no further notice

here, except to note that the cervical ribs in Nos. 84 and 94 are much smaller in comparison with the size of the vertebræ than are those figured by Marsh in his description of *D. longus.*

The free or articulating ribs of the dorsal region are ten in number on either side. Of these eighteen are preserved in No. 84 and those of the right side are essentially complete, save the second, which is wanting in the right series but present in the left, though the extreme distal end and the capitulum and tuberculum are wanting.

The first rib differs from all the others in being triangular in cross section throughout its entire length, except for a short distance just beyond the union of the capitulum and tuberculum. It diminishes regularly but very gradually in size from the point of union of the capitulum and tuberculum to the distal extremity. The latter is triangular in cross section and pointed, without any indication of the distal expansion commonly seen in the first rib of the larger mammalia. The external surface of this rib is rather broad proximally and is produced posteriorly into a rather stout blade and anteriorly into a somewhat shorter projection, so that in this region a cross-section of this rib would be T-shaped with one arm more abbreviated than the other. The capitulum and tuberculum are small, subequal, and supported by peduncles of about equal length, though the tubercular process is slightly longer and stronger than the capitular.

The second rib is wanting in the right series, but is represented in the left, though lacking the extremity and the capitulum and tuberculum. The external surface is broad and rather flat throughout the entire length. The inner surface is deeply convex throughout the greater part of the length of the rib, but toward the extremity it becomes gradually flattened, resulting in a thin, flat, spatulate extremity contrasting strongly with the triangular pointed extremity of the preceding rib.

The third rib like the first is quite complete. The tuberculum and capitulum are each pedunculate, compressed and subequal in area, while their supporting processes are about equal in length. The external surface is broad proximally, somewhat contracted medially, and slightly expanded distally, where the anterior edge is produced into a sharp ridge. The inner surface is convex. In cross section it is somewhat elliptical throughout the greater portion of its length, but proximally it is T-shaped, with the outer surface forming the top of the T.

The fourth rib is complete. The head and tuberosity of this rib are the largest of any in the series. They are borne at the extremities of their respective processes, and the capitular process is somewhat longer and more slender than the tubercular. This rib is triangular in cross section proximally but much flattened distally.

The fifth rib is in general form like the fourth. It is slightly longer and the

articular surface of the capitulum and tuberculum are smaller. The latter is borne by a very short process, while the capitular process is long and slender.

The sixth rib is of about the same length, but more slender than the fifth. It is flat throughout most of its length, but triangular proximally. The tuberculum and capitulum are small and the former is sessile while the latter is pedunculate.

The seventh rib is long and narrow. It is rather stout throughout the proximal two thirds of its length, but distally it expands into a somewhat broader but thin blade. The tuberculum is sessile and the capitulum pedunculate. They are each circular in outline.

The eighth rib is very slender. It maintains about the same dimensions throughout its entire length, though the transverse diameter decreases somewhat distally. The tuberculum is nearly sessile, while the capitulum is supported by a slender process. The articular facets are circular in outline.

The ninth rib differs from the eighth chiefly in its shorter length and more slender proportions.

The tenth is the shortest of the series. It is elliptical in cross section medially and very much flattened distally. There is a deep cavity on the posterior side between the capitular and tubercular facets.

From the following measurements it will be seen that the ribs increase regularly in length from the first to the fourth, that the fourth, fifth and sixth are subequal in length, while the posterior ribs decrease rapidly in length from the seventh to the tenth, which is the shortest in the series of free ribs.

Measurement of Ribs.

Length of first rib	1057	mm.	$43\frac{3}{16}$	in.
" " second rib, estimated	1300	"	$52\frac{3}{16}$	"
" " third rib	1590	"	$63\frac{7}{8}$	"
" " fourth rib	1710	"	$68\frac{1}{2}$	"
" " fifth rib	1727	"	69	"
" " sixth rib	1680	"	$67\frac{1}{8}$	"
" " seventh rib	1580	"	$63\frac{1}{4}$	"
" " eighth rib	1330	"	$53\frac{3}{8}$	"
" " ninth rib	1140	"	46	"
" " tenth rib	795	"	$32\frac{1}{4}$	"

The Coracoid and Scapula.—These are firmly coössified in *Diplodocus* and enter subequally into the construction of the glenoid cavity. The scapula is much the larger element of the two. Inferiorly it is broad and with a concave external surface between the superior border of the glenoid cavity and the anterior border of the widely expanded prescapula. Superiorly and posteriorly the scapula is pro-

duced into a long, narrow and thin postscapula, slightly constricted medially, but expanded distally and with the external surface transversely convex. The coracoid is short, stout, and firmly united with the scapula, the suture remaining throughout more or less distinct. In outline the coracoid is not unlike a quadrant of an ellipse, quite thin along the periphery and much thickened at the central angle, which is bounded by the coracoscapular suture and the inferior border of the glenoid cavity produced into the posterior border ef the coracoid, and thus forming respectively the longer and shorter radii of an ellipse. There is a large foramen in the coracoid near the coracoscapular suture and about midway between the glenoid and anterior

Fig. 14. External view of right scapula and coracoid of *Diplodocus carnegii* (No. 94). About one eleventh natural size.

borders. The inferior border of the coracoid is rugose, thin, and curved rather sharply inward toward the antero-external border of the sternals to which it was perhaps not directly opposed, the union having been either cartilaginous or muscular. Taken together the coracoid and scapula may be described as forming a rather broad and thin plate, much thickened about the glenoid cavity and presenting a generally convex external and concave internal surface when viewed longitudinally. It was thin at the edges but much thickened medially. See Fig. 14.

Measurements. No. 84.

Combined length of scapula and coracoid	1600 mm.	$64\frac{1}{8}$ in.
Greatest " " "	1240 "	$49\frac{7}{8}$ "
" breadth " "	605 "	$32\frac{3}{4}$ "
Least " " "	204 "	8 "
Length of coracoid	512 "	$20\frac{1}{8}$ "
Greatest expanse of glenoid cavity	274 "	$10\frac{1}{4}$ "

The Fore Limb and Foot.—Little is known of the fore limbs and feet of *Diplodocus*. In our collection there are no bones that can positively be referred to these parts. Marsh has figured a complete set of metacarpals which he refers to *Diplodocus*. Through the kindness of Professor Osborn I am able to give the following brief description of the fore limbs as represented by material in the collections of the American Museum, photographs of which have been placed at my disposal. These show that the fore limbs had a length of about three fourths of that of the hind limbs. The humerus was rather slender, somewhat compressed antero-posteriorly, and with a prominent deltoid ridge. Distally the radial articulation was external and anterior to the ulnar, so that these bones were crossed superiorly as in the mammalia. The bones of the forearm were rather long and slender, but somewhat shorter than the tibia and fibula, while the metacarpals were longer than the metatarsals and according to Osborn the carpus was of the mesaxonic pattern and digitigrade.

The Pelvis.—The pelvis of *Diplodocus* is composed of ilium, ischium, and pubis. These all unite to form the acetabulum, which is left open internally. They are not coössified. The superior border or crest of the ilium is semicircular in outline, and is much thickened and rugose. Below this the ilium is quite thin, but along the inferior border it is again thickened and about the acetabulum it attains a thickness of from six to eight inches. There are anterior and posterior expansions of the iliac crest. The former of these is much the longer. Inferiorly the acetabular border of the ilium is produced into a short posterior ischiac peduncle and a very long and stout anterior pubic peduncle. The latter was almost perpendicular when the animal was in its normal quadrupedal position, but when the bipedal or tripodal position was assumed its position became more horizontal and it thus received a correspondingly increased proportion of the weight of the elevated anterior portion of the body. The pubes are broad and stout proximally and much thickened about the acetabular border. The face for articulation with the ischium is broad and triangular. Inferiorly the pubis is produced into a rather long shaft terminating in an expanded club-like tuberosity with a broad internal rugose surface for contact with the corresponding portion of the opposite pubis. The shaft is very thin and sharp along its internal margin and much thickened and rounded externally. There is a prominent rugosity on the anterior portion of the pubis just below the articular surface for the ilium. The articular surface for the ilium is concave in all our pubes. There is a very large foramen just within the ischiac border. The broadly expanded proximal ends of the pubes are concave internally and convex externally. The ischia are the smallest of the pelvic bones. They are much expanded proximally, contracted medially, and slightly expanded distally. The shaft is trihedral in cross

section. Distally the ischia meet medially in a rather extended ischiac symphysis, usually coössified. Proximally the pubic and iliac surfaces are subequal and separated by the very broad and thickened acetabular border. The ischia when adjusted to the other elements of the pelvis present a broadly rounded inferoanterior surface and a rather deep trough superiorly, the bottom of which is formed by the approximation and partial contact of their respective shafts. The principal characters of the pelvis are shown in Pl. X., Figs. 1 and 2, and in the various text figures.

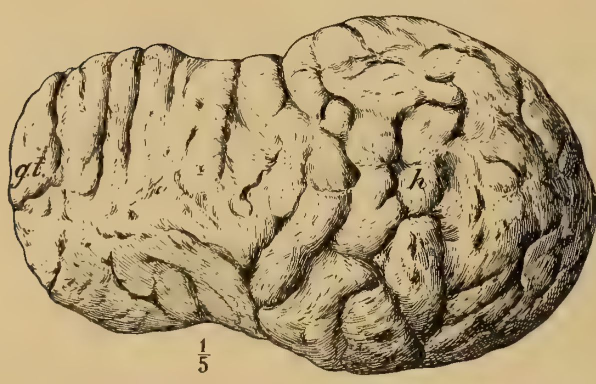
MEASUREMENTS. No. 84.

Greatest length of ilium	1089 mm.	42$\frac{7}{8}$ in.
Height of iliac crest above extremity of pubic peduncle	787 "	31 "
Width of acetabulum	355 "	14 "
Greatest length of pubis	1000 "	39$\frac{3}{8}$ "
" breadth of proximal portion	400 "	15$\frac{3}{4}$ "
" length of ischium	940 "	37 "
" breadth of proximal portion	435 "	17$\frac{1}{8}$ "

No. 94.

Distance between pubic peduncles of opposite sides	758 mm.	29$\frac{7}{8}$ in.
Posterior expansion of ilia	940 "	37 "
Anterior " "	1233 "	48$\frac{1}{2}$ "

The Femur.—When compared with the femur of *Brontosaurus* that of *Diplodocus* is proportionately more slender and the head is placed at right angles to the shaft of



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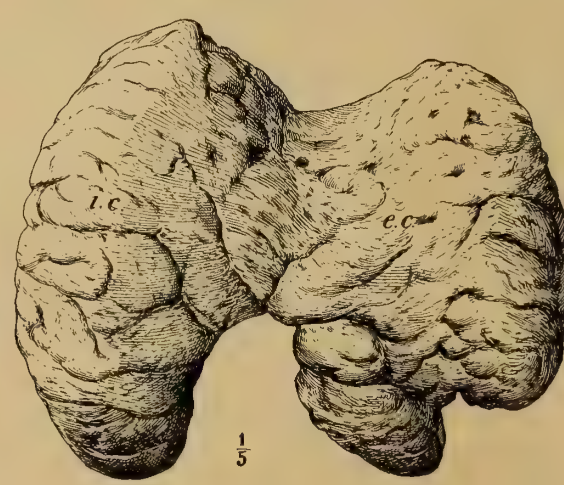

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FIG. 15. Proximal end of left femur of *Diplodocus carnegii* (No. 94). *h*, head; *g. t.*, greater trochanter. One fifth natural size.

FIG. 16. Distal end of left femur of *Diplodocus carnegii* (No. 94). *e. c.*, external condyle; *i. c.*, internal condyle. One fifth natural side.

the bone so as to occupy the same plane as the external and internal condyles of the distal end. By reason of this a femur of *Diplodocus* when lying on a plane surface with posterior surface down will be supported by the head and external and internal condyles, while a femur of *Brontosaurus* lying in the same position would have the head directed obliquely upward and free from the supporting surface. The shaft in cross section is flattened antero-posteriorly and somewhat elongated transversely, with the internal surface deeper than the external, so that the cross section is ovate in outline, tending to form distally a more or less perfect ellipse. The greater trochanter is not distinctly separated from the head and the rugose surface of the latter is continued uninterruptedly and covers the superior surface of the greater trochanter. There is a faint constriction, but no well-defined neck connecting the head with the shaft of the femur. The external and internal condyles are large and well separated by a deep intercondylar groove. The external is divided into two parts, one external and the other internal, by a deep posterior median groove which doubtless served for the transmission of a strong tendon. The third trochanter is present, but small. Internal to and directly alongside it there is a small but quite rugose flat surface for increased muscular attachment. The third trochanter in *Diplodocus* is not homologous with the same trochanter in mammals. It is situated on the inner and posterior margin in *Diplodocus* instead of on the outer as in mammals, when present. In mammals it curves forward, while in *Diplodocus* it is directed directly backward. Figs. 15 and 16 represent respectively the proximal and distal extremities of a femur, No. 94, of *Diplodocus*, while lateral and front views are given in Pl. XI., Figs. 3 and 4, and an oblique internal front view is shown in Fig. 17.

FIG. 17. Oblique internal front view of left femur of *Diplodocus carnegii* (No. 94). *tr.*, third trochanter. About one eleventh natural size.

MEASUREMENTS OF No. 84.

Greatest length	1542 mm.	$61\frac{3}{4}$ in.
" breadth at proximal end	500 "	$17\frac{7}{8}$ "
" " " distal "	412 "	$16\frac{1}{4}$ "

No. 94.

Greatest length	1470 mm.	$56\frac{7}{16}$ in.
" breadth at proximal end	390 "	$16\frac{1}{4}$ "
" " " distal "	365 "	$15\frac{3}{8}$ "

The Tibia and Fibula.—These are rather slender bones. The fibula is much the more slender and a little longer than the tibia, since it differs from the same bone in mammals by entering subequally with the tibia into the ectocondylar articulation with the femur, while inferiorly it is produced into an extended external malleolar portion which reaches well below the distal end of the tibia, abuts against the external side of the astragalus, having entirely displaced the calcaneum, and reaching almost to the proximal ends of metatarsals four and five. It is subequal in transverse diameter throughout, but expanded antero-posteriorly at the extremities, more especially at the proximal end, where it presents a flat internal surface and rather thin anterior edge which fits into the broad groove formed by the recurved cnemial

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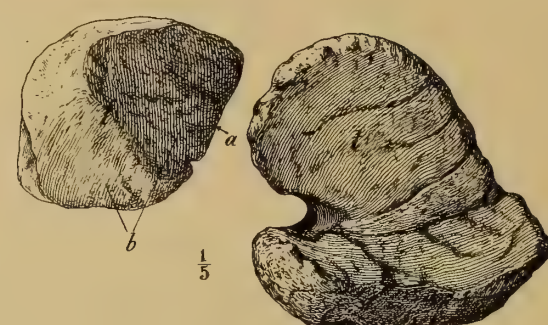

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FIG. 18. Proximal end of right tibia and fibula of *Diplodocus curnegii* (No. 94). *t*, tibia ; *f*, fibula. One fifth natural size.

FIG. 19. Distal end of right tibia and fibula of *Diplodocus carnegii* (No. 94). *t*, tibia ; *f*, fibula ; *b*, surface for metatarsals I. and II. *a*, surface for contact with external side of astragalus. One fifth natural size.

crest of the tibia, while the flattened proximal surface is closely applied to that bone. A little less than half the distance from the proximal to the distal end there is on the antero-external border of this bone a rather broad rugose area for muscular attachment. Distally the fibula is produced below the end of the tibia and expands into a broad, thick external malleolus which fits into and articulates laterally with the external surface of the astragalus. The proximal end of the tibia is much expanded antero-posteriorly and less so transversely. The shaft is quite slender, but expands again distally so as to entirely cover the superior surface of the astragalus. On its internal and posterior distal extremity it sends downward an internal malleolus which is separated from the main shaft of the bone by a deep groove for the transmission of the tendons of the flexor muscles of the foot. This process articulates

with the posterior and internal surface of the astragalus. This arrangement of the articular surfaces between the tibia, fibula, and astragalus allows of considerable movement antero-posteriorly, while at the same time prohibiting almost all lateral movement. It forms an exceedingly strong ankle joint similar to that which obtains in ungulate mammals, and was especially well adapted to resist the strains to which the ankle would have been subjected in the perambulations of so massive an animal. Figs. 18 and 19 represent respectively the proximal and distal extremities of tibia and fibula of No. 94. External and front views of these bones are shown in Pl. XI., Figs. 1 and 2.

Measurements of No. 94.

Greatest length of tibia	1006	mm.	$40\frac{5}{8}$	in.
" breadth at proximal end	274	"	$11\frac{3}{4}$	"
" " " distal "	195	"	$8\frac{7}{16}$	"
" length of fibula	1050	"	$43\frac{3}{8}$	"
" breadth at proximal end	213	"	$9\frac{3}{8}$	"
" " " distal "	155	"	$7\frac{1}{8}$	"

The Pes.

The Tarsus.—The osseous portion of the tarsus in *Diplodocus*, as in the allied genus *Brontosaurus*, has been reduced to an astragalus. This is a very broad bone, deep externally, but rather thin, flat, and contracted internally. Superiorly it covers the entire distal end of the tibia, with which it articulates by a continuous articular surface, which is high and slightly convex externally, but low and somewhat excavated internally, in order to accommodate the inferiorly produced internal malleolus of the tibia. The external surface is separated from the anterior by a rather pronounced ridge, but the articular surfaces of the two faces are confluent. The anterior surface of the astragalus presents a broad, smooth, regularly convex surface for articulation with the proximal ends of metatarsals I., II., III., and the inner proximal portion of metatarsal IV. The external portion of the astragalus is high and deep and presents a deeply excavated lateral surface with an expanded anterior and inferior margin developed into a long, narrow, semi-circular articular surface, which is opposed to the internal margin of the distal end of the fibula. Posteriorly the astragalus is much constricted, and consists of a comparatively narrow ridge regularly concave vertically and convex laterally, and separating the large external lateral cavity just mentioned from a similar, but smaller, internal lateral cavity. Inferiorly the astragalus presents a broad, rugose, and regularly convex plantar surface. This in life was evidently covered with thick cartilaginous pads which were directly op-

posed to the ground when the animal stood erect. A superior view of the astragalus is shown in Fig. 20.

The Metatarsus.—As in *Brontosaurus* the metatarsus of *Diplodocus* is composed of five well-developed functional metatarsal bones. Of these I. and II. are much stronger than III., IV. and V. and formed in life the chief support to the hind limb. Metatarsals III., IV. and V. are comparatively slender, more so than are the same elements in *Brontosaurus*, as compare Figs. 20 and 21. The two latter were opposed to the distal end of the fibula and not to the astragalus. Metatarsal I. is the shortest and strongest of the series. It is constricted medially, expanded vertically at the proximal, and laterally at the distal extremity, as are also the other metatarsals. Metatarsal II. is considerably longer and more slender than I. Metatarsal III. is the longest in the series, though IV. and V. are only slightly shorter. Metatarsal IV. is the more slender of the series, while V. is much more robust and presents a rather broad and rugose distal surface.

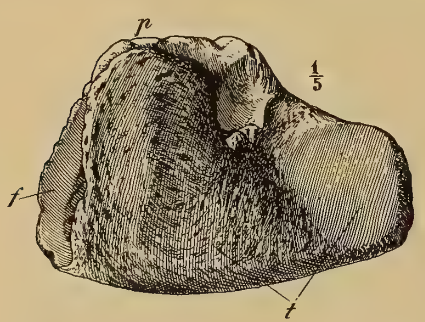

Fig. 20. Superior view of astragalus of right pes of *Diplodocus carnegii* (No. 94). *t*, surface for articulation with tibia; *f*, surface for articulation with fibula; *p*, posterior side. One fifth natural size.

The Phalanges.—These will best be described by commencing with those of the first digit and considering each serially from the first to the fifth. The first digit supports two phalanges, one, the proximal, is short, broad and deep, and supports distally a very large, long, deep, curved and compressed claw-like ungual which in life was evidently enveloped by a horny sheath, as is evidenced by the grooved and pitted external surface. The second digit supports three phalanges. The proximal is rather longer than that of digit I. and with the three dimensions subequal. It is stout, with its inner side nearly perpendicular, while externally the surface slopes downward and outward, terminating inferiorly in a rather sharp ridge. The succeeding phalanx is reduced to a rather flat wedge of bone about one inch in thickness on its internal side and reduced to a sharp thin wedge externally. It is thus introduced as a rather thin wedge between phalanges one and three. The latter is rather large and much compressed ungual, differing chiefly in its smaller size from that of digit I. Both these unguals show an extensive proximal articular surface indicative of a considerable vertical movement of these phalanges. They are also directed rather sharply outward as well as forward. The proximal phalanx of digit III. is slightly longer than broad, while its other two dimensions are subequal. Phalanx

two is a short wedge-shaped bone about one inch long on its internal lateral margin and ending in a sharp lateral ridge externally. Just beneath this bone in No. 94 of our collections, and adhering to it, there was found a very small and rather flat bone which may have been either a rudiment of a third phalanx or a sesamoid. Its position would seem to indicate the latter, though quite similar rudimentary third phalanges are known to be present in the third digit of *Brontosaurus*. I therefore interpret it as a rudimentary third phalanx. There was evidently a well-developed and functional ungual, or fourth phalanx, terminating digit III., although it was not recovered. In digit IV. the phalanges are reduced to two in number. Of these the proximal is much the larger. It is rather depressed, but laterally ex-

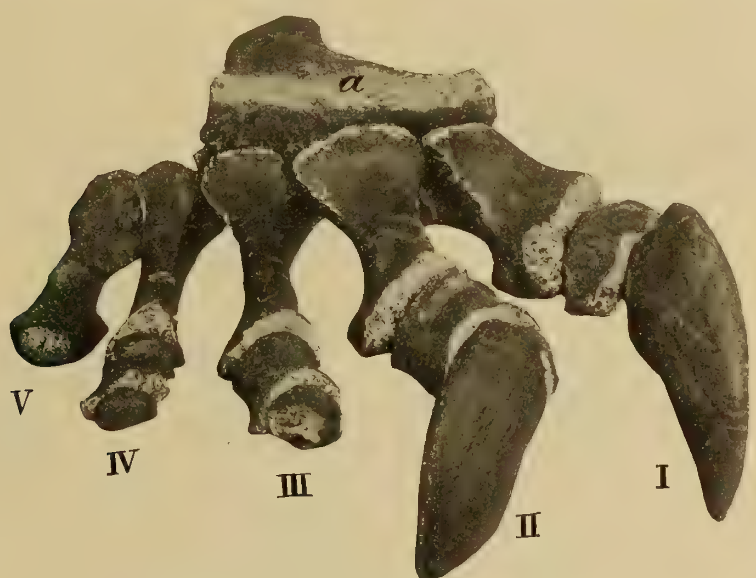

FIG. 21. Front view of right hind foot of *Diplodocus carnegii* (No. 94). *a*, astragalus.

panded distally, and supports a small, rounded, hemispherical terminal phalanx which in life was without horny covering and was probably imbedded within the integument of the skin. No phalanges were found in position with the fifth metatarsal, but as in *Brontosauras* there was most likely a small, rudimentary first phalanx without nail.

From the above description and accompanying figures it will be seen that the pes of *Diplodocus* is semi-plantigrade and that the weight of the body was borne by the inner side of the foot, so that digits one and two became correspondingly larger, while three, four and five through disuse have become more and more atrophied. Although in *Diplodocus* this had not yet resulted in the total elimination of any of the digits, yet the phalanges of the fifth have already become functionally obsolete.

It is interesting to note that while in the Mammalia digit I. it is the first to become obsolete, in the Dinosauria the reduction would seem to have commenced in the pes with the fifth, while the first digit appears as functionally the most important of the series. Though there are only two phalanges supported by it these are exceptionally well developed. Commencing with digit I. the normal number of phalanges on any digit in the pes of *Diplodocus* is as in most birds, always one more than the number of such digit. Thus the first digit has two phalanges, digit II. has three and the third digit has four. But in digits IV. and V. the number of phalanges

FIG. 22. Front view of right hind foot of *Brontosaurus excelsus* Marsh (No. 89).

are reduced to two and one respectively by atrophy due to disuse. There can be little doubt that as regards the hind feet *Diplodocus* walked on the inner side of the feet with the large terminal claws directed very strongly outward. The above description of the pes and hind limb of *Diplodocus* is based upon a right femur of No. 84 and a left femur and right tibia, fibula and foot of No. 94, complete except for the ungual phalanx of digit III. and the solitary phalanx of digit V. The principal characters are well shown in Fig. 21, while Fig. 22 shows a foot of *Brontosaurus* for comparison.

Fig. 23. Cross sections of left femur of *Diplodocus carnegii* (No. 94). *a*, *b*, near middle of shaft; *c*, near proximal end.

Principal Measurements of the Different Elements of the Foot.

Greatest width of astragalus	260 mm.	$10\frac{1}{4}$ in.
" depth " "	160 "	$6\frac{1}{4}$ "
" length of metatarsal I	210 "	$8\frac{1}{4}$ "
" " " " II	207 "	$8\frac{1}{8}$ "
" " " " III	215 "	$8\frac{7}{16}$ "
" " " " IV	190 "	$7\frac{7}{16}$ "
" " " " V	160 "	$6\frac{5}{16}$ "
" " " ungual phalanx of digit I	235 "	$9\frac{1}{4}$ "
" " " " " " " II	136 "	$5\frac{5}{16}$ "
" depth " " " " " I	175 "	$6\frac{7}{8}$ "
" " " " " " " II	105 "	$4\frac{1}{8}$ "

Internal Structure of Limb Bones.

Marsh has described the limb bones of the Sauropoda as solid and has considered this character as of subordinal value.

A careful examination of cross sections made at almost any point in any of the larger limb bones of the Sauropoda will show that they are not solid, but consist externally of a comparatively thin portion of rather dense, hard bone, grading off quite suddenly into a cancellated structure. This becomes more openly cancellate toward the interior, and there is formed in the center of the shafts of the larger bones distinct cavities quite devoid of osseous matter. Such conditions are especially prevalent in the femora. See Fig. 23, *a*, *b*, *c*, from photographs of cross sections taken at different points of the left femur of No. 94.

Taxonomy.

Marsh has elevated the Dinosauria to the rank of a subclass, dividing the different genera into three orders. One of these, the Theropoda, includes all the carnivorous Dinosauria, while the herbivorous forms are placed in two orders, the Sauropoda and the Predentata.

The Sauropoda, to which *Diplodocus* belongs, are the least specialized of the three Dinosaurian orders. This order embraces several genera, chiefly from the Jurassic of North America, while a few forms have been described from the Jura of Europe and the Cretaceous of India, and two or three imperfectly known genera from the Cretaceous of South America have been assigned to the Sauropoda, though some of these latter forms may perhaps yet prove to belong to the Predentata rather than the Sauropoda.

Diplodocus was the most specialized member of the Sauropoda. This specialization is seen in the elongated caudal and cervical regions and the abbreviated dorso-

lumbar region; in the exceedingly complicated structure of the individual vertebræ; in the marked reduction in the size and number of the teeth, and in the more reduced nature of digits III., IV., and V. in the pes. Thus while the Sauropoda include the more generalized of the Dinosauria, *Diplodocus* exhibits the greatest specialization attained by the different genera of this order in so far as the characters of the various genera are now known.

So little is known of the structure of many of the genera of Sauropodous Dinosaurs that no attempt can at present be made to trace the phylogeny of the different genera and species. Marsh has proposed six families for the Sauropoda, viz.: (1) Atlantosauridæ; (2) Diplodocidæ; (3) Morosauridæ; (4) Pleurocœlidæ; (5) Titanosauridæ; (6) Cardiodontidæ. The first four of these are all from the Jurassic of North America, and the second and fourth (Diplodocidæ and Pleurocœlidæ) should probably be united in one family, the Diplodocidæ. The Titanosauridæ are from the Cretaceous of India and Patagonia and may eventually prove to belong in part at least to the Predentata, while the Cardiodontidæ are from the Jurassic and lower Cretaceous of Europe.

The Sauropoda attained their greatest development both as regards size and number, not only of individuals, but of genera and species as well, at about the close of the Jurassic, while with the advent of the Cretaceous they appear to have commenced to decline, entirely disappearing toward the close of that period, where they are replaced by members of the more highly specialized carnivorous Theropoda and herbivorous Predentata, the remains of which occur in great abundance in the Laramie deposits of our Western plains.

The Species of Diplodocus.

Marsh has proposed two species of *Diplodocus*. One, *Diplodocus longus*, is the type of the genus as well. It was first described in *The American Journal of Science and Arts*, Vol. XVI., Nov., 1878, p. 414, and its description was based upon certain vertebræ and chevrons from the mid-caudal region. The hind limb and feet described in the same publication as belonging to the same individual evidently do not pertain to *Diplodocus*, but to *Brontosaurus*, and the feet of *Diplodocus* are now known to be quite different from what Marsh had supposed them to be in the article above referred to. The caudal vertebræ and chevrons described by Marsh should be taken as the type in *Diplodocus longus* of both genus and species. The deposit from which the remains were taken was a general bone deposit or quarry, and Marsh was undoubtedly led by the proximity of the limb bones and caudal vertebræ described to refer them to the same individual, a very natural conclusion, but one

which later discoveries have shown to be erroneous. The material was from Cañon City, Colorado, and was collected by Dr. S. W. Williston.

A second species, based upon material collected by Professor Arthur Lakes, at Morrison, Colorado, was described by Marsh as *D. lacustris* in the same journal for February, 1884, page 166. He simply characterizes it as of smaller size and with more slender jaws. It is very probable that the Sauropoda, like the Crocodilia and most other Reptilia, continued to grow throughout the entire life of the individual, and that their immense size is indicative of a very long life. It would thus appear that size alone is an exceedingly unsatisfactory character from which to describe or determine species among these animals. Moreover, we have elsewhere spoken of the remarkable asymmetry exhibited in the same vertebra and of the marked contrast in form of the adjacent vertebræ in the same series, all of which characters indicate a considerable individual variation among the Diplodocidæ. Nevertheless there are certain structural differences that hold good with little variation throughout certain parts of the vertebral column in the known skeletons of *Diplodocus* that may with reason be considered as of at least specific importance. Such, for instance, are the direction of the spines of the caudals, as exhibited in the American Museum specimen and figured by Osborn and reproduced here. These in the American Museum skeleton, except in the extreme posterior portion of the tail, rise almost directly upward instead of being directed regularly upward and backward as in Nos. 84 and 94 of the Carnegie Museum collections. Compare Pls. XII. and XIII. Also the great disparity in the relative size of the cervical ribs as exhibited in our skeletons (Nos. 84 and 94) and as figured by Marsh in his description of *D. longus* are certainly of specific importance, as will be shown by a comparison of Fig. 24 (after Marsh) with the cervical series shown in Pl. III. The free spine of the third sacral in No. 94 might perhaps be also considered as of specific importance, although I am inclined to believe it more probably due to the somewhat younger age of the individual as indicated by its smaller size.

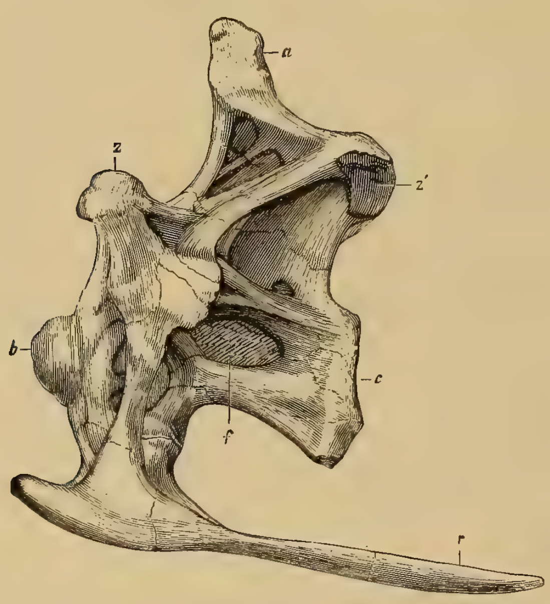

FIG. 24. Cervical vertebra of *Diplodocus longus* Marsh. One eighth natural size. After Marsh.

In view of the above-noted differences between *D. longus* as described by Marsh and Osborn, I consider our skeletons (Nos. 84 and 94) as belonging to a distinct species for which I propose the name of *Diplodocus carnegii* in honor of Mr. Andrew Carnegie, the founder of this institution, and in recognition of his interest in vertebrate paleontology; which interest he has abundantly and substantially shown in providing the necessary funds for organizing and maintaining a Section of Vertebrate Paleontology in connection with this Museum. No. 84 may be taken as the type of this new species, while No. 94 should be considered as the cotype.

The principal characters of *D. carnegii* have been given in the foregoing pages. From *D. longus* it is readily distinguishable by the smaller cervical ribs and by the caudal spines which are directed much more strongly backward than are those in the latter species.

Restoration of the Skeleton of Diplodocus.

The present restoration is based upon a careful study of skeletons No. 84 and 94 of the Carnegie Museum collections supplemented by the material brought together by the late Professor Marsh and now in the U. S. National Museum, and by the excellent material of the American Museum of Natural History in New York. The vertebral column is for the most part taken from No. 84, which is complete from the axis to the twelfth caudal inclusive. The atlas and skull are taken from Marsh's figures, while the posterior caudals are taken for the most part from No. 94 supplemented by Professor Osborn's figures of the splendid caudal series in the collections of the American Museum. The pelvis, scapula, ribs, coracoids, and femur are from No. 84. The tibia, fibula and pes are from No. 94, which, like the American Museum specimen, represented a somewhat smaller individual than that of No. 84, as will be seen by a comparison of the different measurements. The fore limbs and feet are from a second individual in the collections of the American Museum, for the use of which I am indebted to the kindness of Professor H. F. Osborn, to whom also I wish to make acknowledgment for several valuable suggestions which have been especially helpful in the preparation of the present paper.

In the present restoration the animal is represented in a quadrupedal position as seen from the right side. The position is one which it is believed the animal must have frequently assumed when feeding upon the soft and succulent plants that grew in abundance along the shores of the shallow waters about and in which these Dinosaurs lived in late Jurassic and early Cretaceous times. The slender skull, provided with but few and rather weak teeth, was supported by a very long and flexible neck which permitted of an almost unlimited variety of movements throughout a considerable arc.

The restoration at once reveals the unusual proportions of *Diplodocus*. The remarkable long neck and tail contrast strikingly with the short body. The hind limbs are longer than the fore limbs, and this fact, together with the enormous elevation of the spines of the sacrals and posterior dorsals, fixes the sacral region as the highest in the vertebral column, a determination first made by Osborn. The powerful ilia, firmly united to the rigidly coössified sacrals with lofty coalesced spines, together with the other pelvic elements proportionately well developed, at once emphasizes the paramount importance of the pelvic region and fixes it as the center of power and motion. The elevated spines, long chevrons, and broadly expanded and rugose diapophyses of the anterior caudals, indicate for this region a very powerful musculature which in life enabled this appendix to serve both as an effective weapon and an important organ of locomotion both for swimming when in water and as a balancing organ when on land, while the modified nature of the chevrons of the mid-caudal region indicate the point of contact of the tail with the earth attending the different positions habitually assumed during the life of the individual. The body proper was abnormally short in comparison with the neck and tail. There were no true lumbars, all the vertebræ of the dorsolumbar region having borne ribs. While the body proper was unusually short, it was deep, as indicated by the ossified ribs of the mid-dorsal region, which have a length of over five feet, while the absolute girth of the body was probably much increased by cartilaginous abdominal and sternal ribs, which latter doubtless served to attach the ossified ribs to the sternal elements. Thus, notwithstanding the extremely short nature of the body of *Diplodocus*, the capacity of the abdominal and thoracic cavities were rendered adequate by its great depth. Moreover, the actual length of the thoracic cavity is much increased from the scapulas being partially swung from the posterior cervical.

The fore limbs and feet of *Diplodocus*, and, indeed, of the Sauropoda generally, are less perfectly known than any of the other portions of the skeleton. In the present restoration they are entirely taken from materials in the collections of the American Museum of Natural History in New York. Concerning the humerus, radius and ulna, there can be no mistake, as these are drawn from photographs of actual specimens loaned by Professor Osborn for the purpose. Of the arrangement of the elements of the manus there is much less certainty. As yet no manus of *Diplodocus* or of the other genera of Sauropoda has been found in position. The lack of a close and exact articulation between the bones in the Sauropoda renders it impossible to place the different elements of the manus, when found separated, in their exact and proper positions with a degree of absolute confidence. Professor Osborn in his study of the limbs of Dinosaurs has considered the fore feet of the

Sauropoda as constituted on the mesaxonic plan, and in the present restoration that plan has been followed entirely upon the authority of Osborn. There is, indeed, a striking contrast between the supposed mesaxonic arrangement in the manus and the entaxonic arrangement that is known to obtain in the pes. Nevertheless Osborn has shown that there are some very strong evidences in favor of such an arrangement in the fore feet, and strikingly different as would then be the structure of the fore and hind feet, yet it would be no more striking that which is known to prevail among certain recent sloths in the Mammalia.

The most striking features brought out by the present restoration are the ridiculously short dorsolumbar region and the exceedingly small size of the skull and anterior cervicals when compared with the great length and size of the animal. The abbreviation of the dorsolumbar region is accomplished both by the reduced number of dorsals and by the shortening of the centra of the individual vertebræ of this region. While in the caudal and cervical regions length is gained both by an increase in the number and in the length of the individual vertebræ in either series, in the caudal series length is gained chiefly by increasing the number of vertebræ, while the cervical region owes its elongation for the most part to the great length of the individual vertebræ, especially in the posterior and mid-cervical regions, though the number of cervicals is also considerable, not less than fifteen.

Probable Habits of Diplodocus.

As first noted by Professor Marsh, the position of the narial opening at the apex of the cranium in *Diplodocus* is indicative of aquatic habits. Moreover, the extreme modifications of the limb bones, vertebræ, and, indeed, of all the larger bones of the skeleton, whereby the greatest possible area for muscular attachment is afforded with the least possible increase in weight, are adaptations admirably calculated to increase very considerably the buoyancy of so massive an animal when in water. The deeply pitted articular surfaces of the various parts of the appendicular skeleton are perhaps indicative of thick cartilaginous pads interposed between such surfaces at the various joints of the limbs and feet. This want of closely fitting and well-defined articular surfaces would appear to afford additional evidence in favor of aquatic habits, and that the movements of the animal when on land were decidedly slow and clumsy, for had *Diplodocus* and its ancestors been addicted to terrestrial life the habitual support of so massive a body in so light a medium as the atmosphere would scarcely have failed to produce closely applied and well-finished articular surfaces, similar to those which obtain in such members of the Theropoda as are of undoubted terrestrial habits. From the above consideration I am inclined

toward the opinion that *Diplodocus* was essentially an aquatic animal, but quite capable of locomotion on land. Though living for the most part in the more important rivers and freshwater lakes, it may not infrequently have left the water and taken temporarily to the land, either in quest of food or in migration from one to another of adjacent bodies of water. Not only would an aquatic life seem to harmonize best with the anatomical characters of *Diplodocus* as we know them, but such a habitat would also afford these comparatively helpless animals the greatest possible protection from the huge terrestrial carnivorous Dinosaurs which lived contemporaneously with them and were undoubtedly their constant enemies.

Bearing in mind the enormous size of the animal and the great quantity of food necessary for its sustenance, in consideration with the extremely small and almost edentulous skull, it will readily appear how important to the existence of these animals was the nature of their environments. They were remarkably ill adapted for maintaining themselves amidst varying conditions. Not only was an almost inexhaustible food supply necessary to their existence, but they were also equally dependent upon the nature of the food. The small, pointed, imperfectly socketed rake-like teeth of *Diplodocus*, only present in the anterior portion of the mouth, were of little or no use as masticating organs, but would have served the animal very well as prehensile organs useful in detaching from the bottoms and shores the tender, succulent aquatic and semi-aquatic plants that must have grown in great abundance in the waters and along the shores of the Jurassic streams and lakes in and about which these animals lived. It is not improbable that during the period when these huge dinosaurs lived and flourished over what is now New Mexico, Colorado, Wyoming, Montana, and the Dakotas there prevailed throughout this region physical conditions somewhat similar to those which exist to-day in tropical America and more especially over the coastal plain of the lower Amazon with its numerous bayous and islands, or the more elevated valleys of the interior in the Brazilian provinces of Amazonas and Matto Grosso with their numerous lakes and large rivers surrounded by a dense tropical vegetation with broad, level valleys subject to periodical inundations. It is only in the midst of such conditions that we can suppose it was possible for these animals to have existed, while comparatively very limited climatic or other physical changes affecting either the abundance or nature of their food supply would have rendered their existence precarious and finally led to their extermination. During the late Jurassic and in early Cretaceous times the western portion of the great interior basin of North America was but slightly elevated, and for the most part consistod of vast morasses with occasional open bodies of water connected by deep but sluggish streams. Here in the midst

of an exceedingly luxuriant vegetation, in a moist tropical climate, lived *Diplodocus* and numerous other huge members of the Sauropoda, as well as other Dinosaurs. If we picture these or similar conditions as having prevailed over this region in middle Mesozoic times we may form a very fair idea of the probable environments attending the existence of these monsters. With the beginning of the Cretaceous there began a subsidence over this region, and a great inland sea was formed which gradually encroached upon the habitat of these animals, more and more restricting the area adapted to them, so that at about the commencement of the Upper Cretaceous the entire region formerly occupied by them had become a shallow sea save only certain islands of limited extent and perhaps otherwise poorly adapted as the homes of such animals as were the Sauropoda. In this manner was accomplished the final extermination of this group of Dinosaurs, while the carnivorous Theropoda and the herbivorous Predentata, through their greater ability to adapt themselves to the changed environments, continued on throughout the entire Cretaceous and have left their remains in great abundance imbedded in the sandstones and shales of the Laramie, the closing period of Mesozoic times.

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Explanation of Plates.

PLATE I. Diagram of quarry C, near Camp Carnegie on Sheep Creek, in Albany County, Wyoming. The bones lying within the double full line belong to *Diplodocus* skeleton No. 84. Those in the upper left-hand corner belong to *Diplodocus* skeleton No. 94. Those to the right of skeleton 84 belong chiefly to *Brontosaurus*, *Morosaurus*, and *Stegosaurus*. The several parts of the various skeletons are represented in the relative position in which they were found imbedded in the matrix. The dotted line represents the line of outcrop on the hillside of the bone-bearing horizon. The irregular full line shows the limits to which the quarry was worked during the season of 1900, by Mr. Peterson and party. The double full line shows the limits to which the quarry was worked in 1899 by Dr. Wortman and party. The caudal vertebræ of No. 84 began near the line of outcrop, while the last of the cervicals were found near the upper end of the quarry as worked out in 1899. The scale is about 7 feet to the inch.

PLATE II. Skull of *Diplodocus longus* Marsh, after Marsh.

Fig. 1. Side view of skull in U. S. National Museum.

Fig. 2. Front view of same skull.

Fig. 3. Top view of same skull.

All figures one sixth natural size.

PLATE III. Cervical series of *Diplodocus carnegii* (No. 84), complete except for atlas. Seen from right side; one tenth natural size.

PLATE IV. Cervical series of *Diplodocus carnegii* (No. 84), complete except atlas, from photographs; one eleventh natural size. Seen from right side.

PLATE V. Cervical series of *Diplodocus carnegii* (No. 84). Anterior view, from photographs. About one eleventh natural size. Series complete, except atlas.

PLATE VI. Cervical series of *Diplodocus carnegii* (No. 84). Posterior view, from photographs. About one eleventh natural size. Series complete save atlas, which is wanting.

PLATE VII. Ten anterior dorsals of *Diplodocus carnegii* (No. 84), seen from right side, and posterior view of third dorsal. All figures one tenth natural size. *al*, prespinal lamina; *hl*, horizontal lamina; *azl*, prezygapophysial lamina; *ol*, oblique lamina; *dl*, diapophysial lamina; *pzl*, postzygapophysial lamina; *t*, tubercular facet; *c*, capitular facet; *ms*, median spine.

PLATE VIII. Ten free dorsals of *Diplodocus carnegii* (No. 84). From photographs about one twenty-second natural size. Column 1, anterior view; column 2, posterior view; column 3, as seen from right side. Vertebræ arranged in serial order from dorsal 1 to 10 in each column, commencing at the right with No. 1 and ending on the left with 10.

PLATE IX. Twelve anterior caudals of *Diplodocus carnegii* (No. 84). Column 1, posterior view; column 2, anterior view; column 3, as seen from right side. Vertebræ are arranged consecutively from 1 to 12, commencing at the right in either column. 2 and 3 are coössified and appear as one vertebra in columns 1 and 2. All figures about one twenty-second natural size.

PLATE X. Comparative views of pelvis of *Diplodocus* and *Brontosaurus*.

1. Side view of pelvis of *Diplodocus carnegii* (No. 94). About one eleventh natural size. From a photograph. Owing to crushing, the sacral spines appear rather low, and since the anterior blade of the ilium bends strongly outward, that element is foreshortened and appears rather more pointed than it should. Seen from right side.
2. Posterior view of same specimen.
3. Sacrum and ilium of *Brontosaurus* seen from right side. Pubic peduncle and anterior blade of ilium are incomplete, as is also the top of sacral spines.

All figures about one eleventh natural size.

PLATE XI. Hind limb and foot of *Diplodocus carnegii*.

1. Front view of right tibia, fibula, and foot of *Diplodocus carnegii* (No. 94).
2. External view of same.
3. Front view of right femur (No. 86).
4. External view of same.

All figures about one eleventh natural size.

PLATE XII. Pelvis and caudal series of *Diplodocus longus* Marsh. Seen from left side, about one fortieth natural size. After Osborn.

PLATE XIII. Restoration of *Diplodocus carnegii* Hatcher, one thirtieth natural size.

Diagram of Quarry C. Showing positions of Skeletons 84 and 94. Scale 7 feet to the inch.

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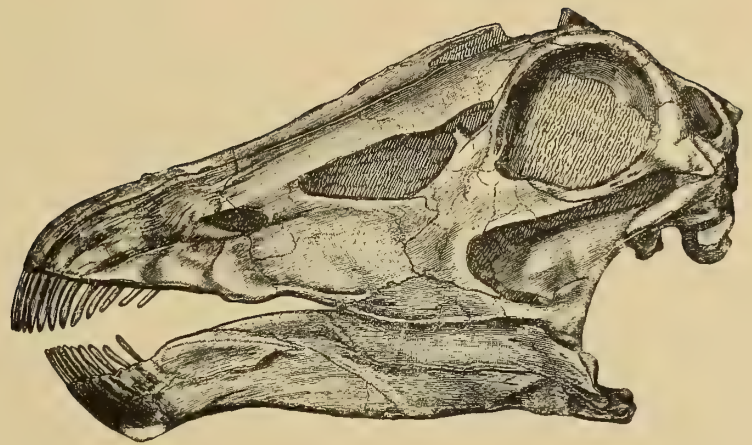

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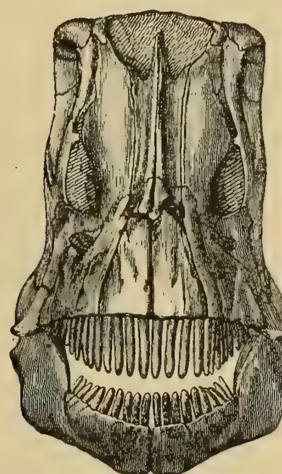

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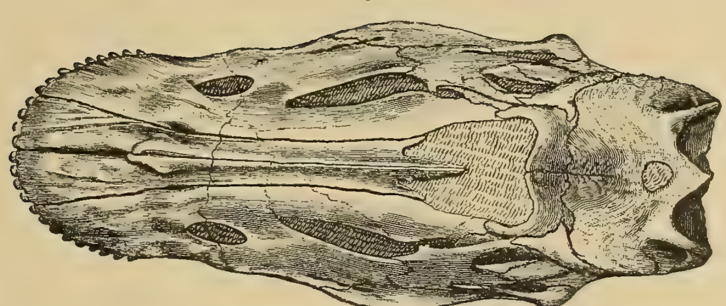
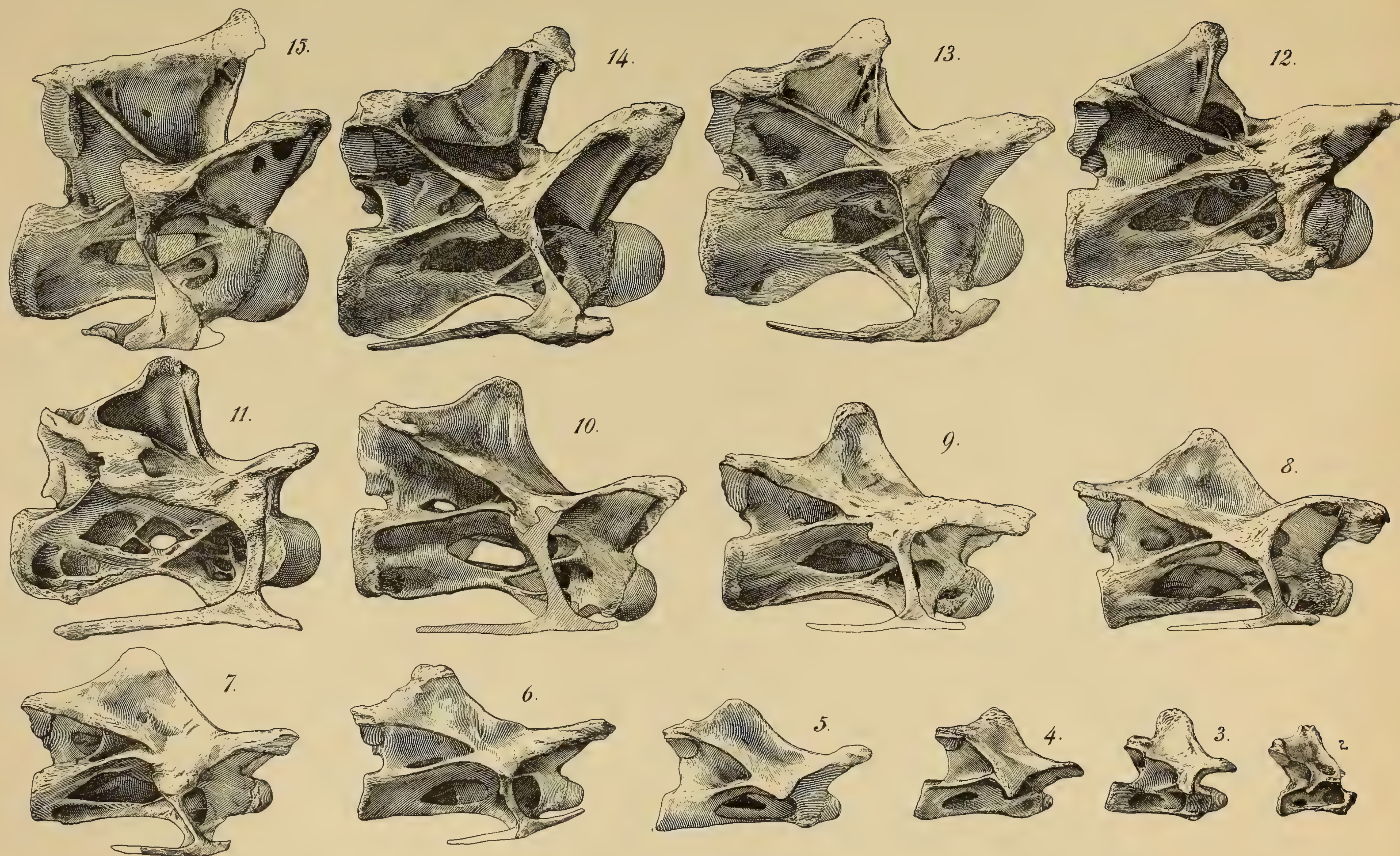
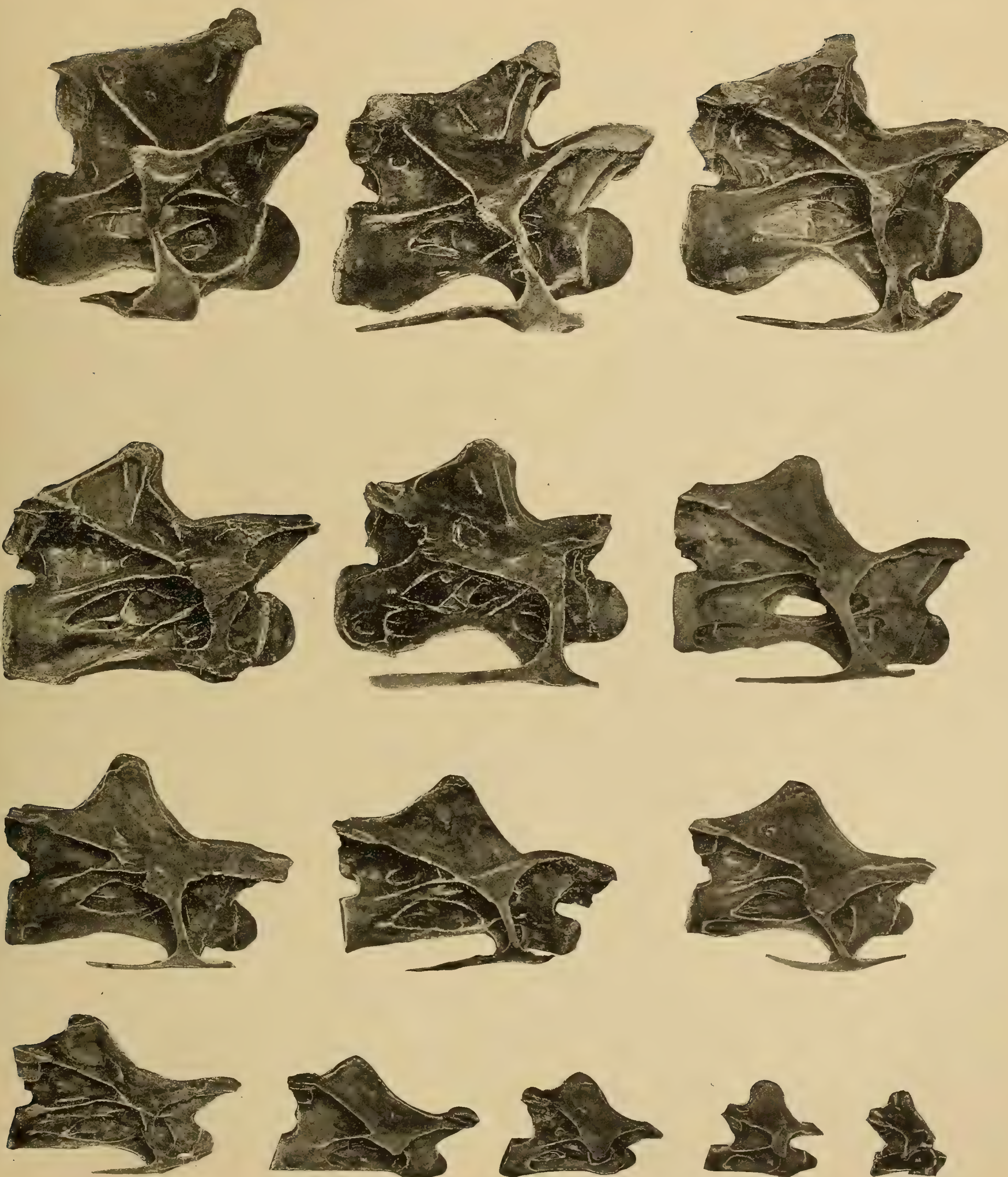


SKULL OF *DIPLODOCUS LONGUS* MARSH, AFTER MARSH. $\frac{1}{6}$ NAT. SIZE.



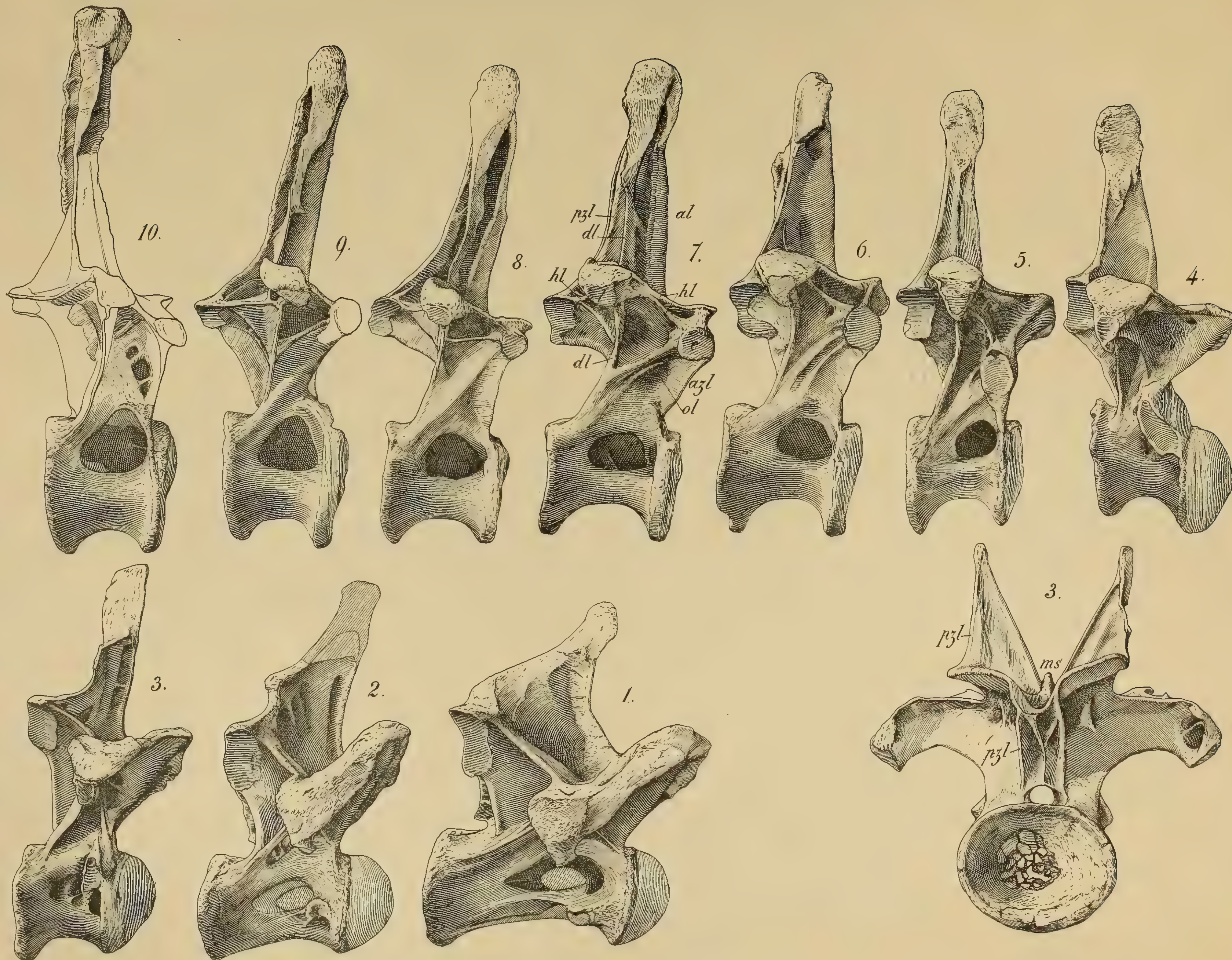
CERVICAL VERTEBRÆ OF *DIPLODOCUS CARNEGII* HATCHER (No. 84). $\frac{1}{10}$ NAT. SIZE.



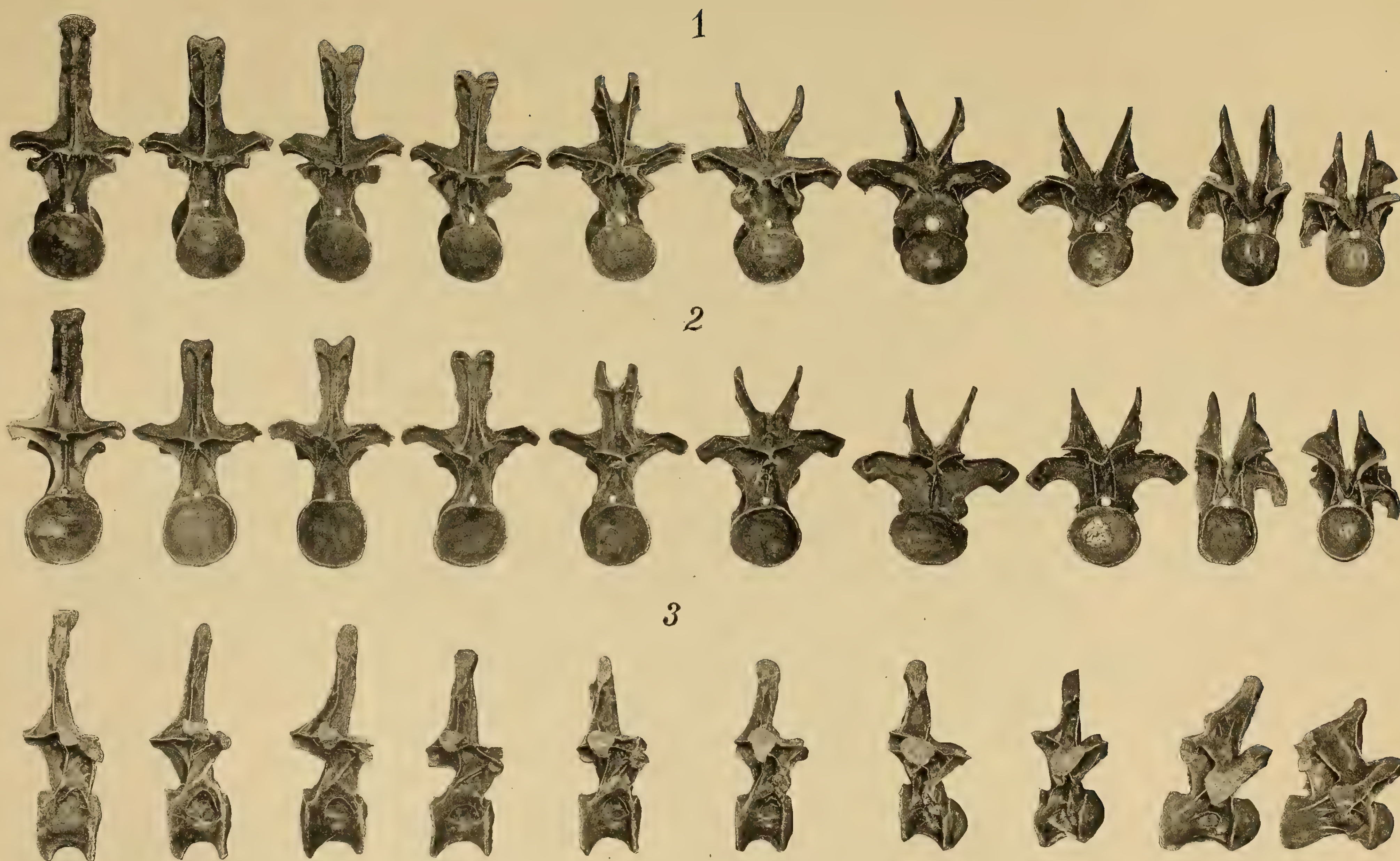
CERVICAL SERIES OF *DIPLODOCUS CARNEGII* HATCHER (No. 84). ATLAS WANTING

ANTERIOR VIEW OF CERVICAL SERIES OF *DIPLODOCUS CARNEGII* HATCHER.

POSTERIOR VIEW OF CERVICAL SERIES OF *DIPLODOCUS CARNEGII* HATCHER.

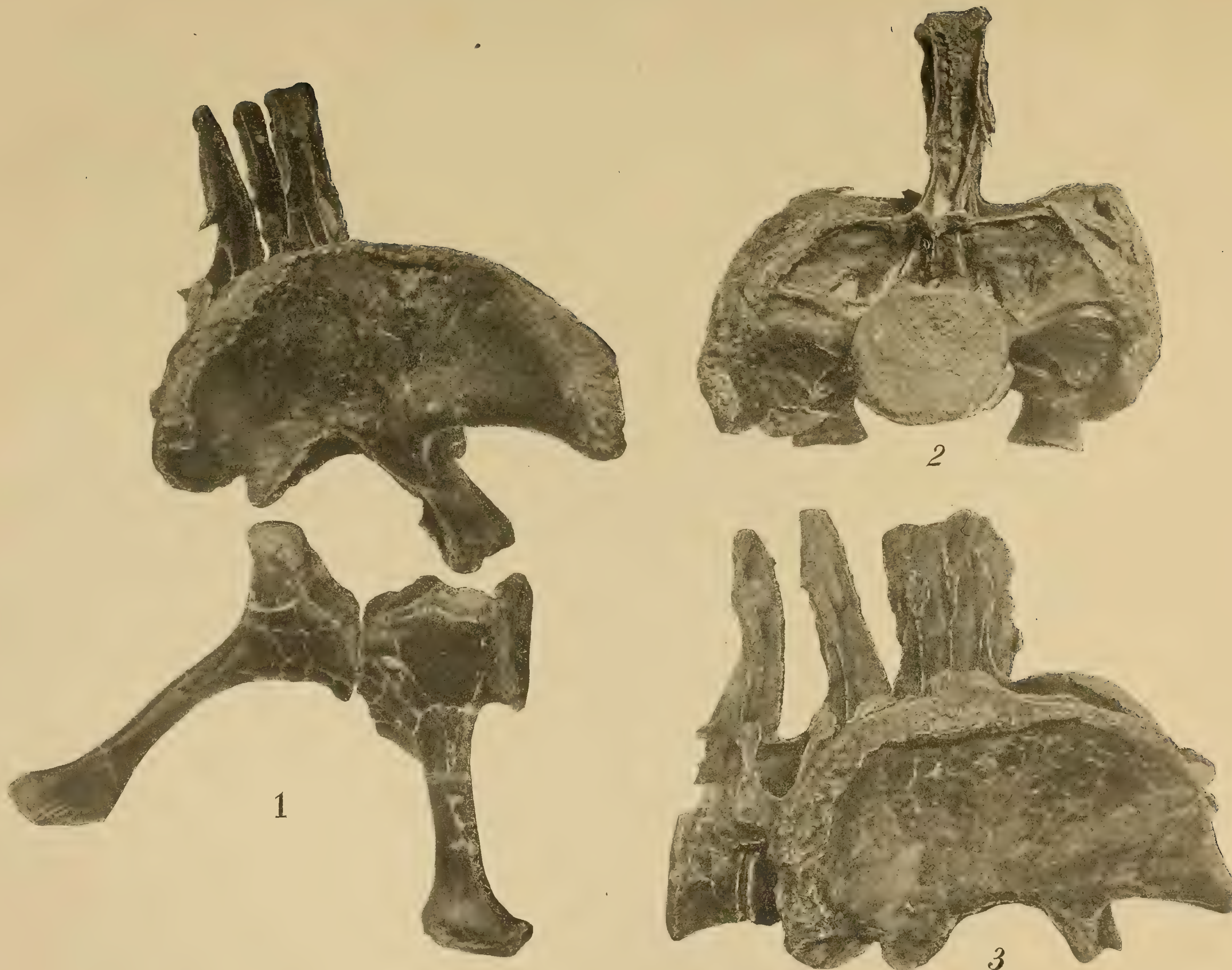


ANTERIOR DORSALS OF *DIPLODOCUS CARNEGII* HATCHER (No. 84). $\frac{1}{10}$ NAT. SIZE.



ANTERIOR, POSTERIOR, AND LATERAL VIEWS OF THE ANTERIOR DORSALS OF *DIPLODOCUS CARNEGII* HATCHER.

POSTERIOR, ANTERIOR, AND LATERAL VIEWS OF TWELVE ANTERIOR CAUDALS OF *DIPLODOCUS CARNEGII* HATCHER.



COMPARATIVE VIEWS OF PELVIS OF *DIPLODOCUS* AND *BRONTOSAURUS*.

HIND LIMB AND FOOT OF *DIPLODOCUS CARNEGII* HATCHER (NOS. 86 AND 94).

Pelvis and Caudal Vertebræ of *Diplodocus Longus* Marsh, after Osborn.

Restoration of the Skeleton of *Diplodocus carnegii* Hatcher. $\frac{1}{30}$ natural size.

MEMOIRS

OF THE

CARNEGIE MUSEUM.

VOL. I. NO. 3.

OLIGOCENE CANIDÆ.

By J. B. Hatcher.

While collecting in the Oligocene deposits in the Hat Creek Basin, Sioux Co., Nebraska, during the season of 1901, Mr. O. A. Peterson was fortunate in discovering an almost complete skeleton (No. 492) of an extinct dog, which I have referred to the species recently described by Prof. W. B. Scott as *Daphænus felinus*, although it differs in certain skeletal and dental characters which by some might be considered as of specific importance.

In about the same geological horizon and in the same general locality (Hat Creek Basin) Mr. Peterson also discovered portions of the skeletons of three other dogs. All of these have the skull for the most part well preserved. One of these (No. 553) pertains to *D. felinus*, while a second (No. 491), I have been unable to identify with any known genus or species. The third (No. 552), which consists of a remarkably complete skull with lower jaw, atlas, axis, third cervical, and other portions of the skeleton, while generically agreeing very well with Cope's description of *D. hartshornianus*, presents such striking differences from those given by Leidy for *D. vetus*, the type of the genus, that I have thought it best to erect for this also a distinct genus and species.

By reason of the remarkably perfect condition of this material, and more especially of the skeleton of *Daphœnus felinus*, which for the first time makes it possible to determine the more important osteological and dental characters of that genus from a single skeleton, I have thought it desirable to figure and describe this material in detail. Notwithstanding the recent contributions by Scott, Wortman, and Matthew to our knowledge of the Oligocene canidæ it is believed that a careful

study of this recently acquired material will add something to our knowledge of the osteology of *Daphœnus* and may perhaps shed some new light on the phylogenetic relations of this genus to the modern carnivora and more especially to the modern canidæ.

Generic Characters of Daphœnus[1] Leidy.

Proc. Acad. Nat. Sci., Phila., 1853, p. 393. *Amphicyon* Leidy (non Lartet), ibid., 1854, p. 157; Ext. Mamm. Fauna Dak. & Nebr., 1869, pp. 32, 356; Cope, Tertiary Vertebrata, pp. 894, 896. *Canis* Cope, Ann. Report U. S. G. S. of the Terrs., 1873, p. 505. *Daphœnus* Scott, Trans. Am. Phil. Soc., Vol. XIX, pp. 325 415; Wortman and Matthew, Bull. Am. Mus. Nat. Hist., Vol. XII, pp. 100–138.

The type species of this genus is *D. vetus*, founded by Leidy on "a cranium without the face, a fragment of a left maxilla containing the posterior three molars, the posterior portion of the left side of the lower jaw containing the last two molars, and a lower ante-penultimate molar of the left side."

Leidy's original description of this genus and species is as follows: "The cranium is elongated and narrow and possesses very much the form of that of the recent *Paradoxurus*. The glenoid articulation is transversely concave as in the weasels, etc. The auditory bullæ are comparatively small. Of the superior posterior three molars, the last is the smallest, and has a simple oval crown; the penultimate is second in size and resembles that of the wolf, but is broader in relation to its antero-posterior diameter; and the ante-penultimate is the largest, and also resembles that of the wolf, but is more trilateral, relatively broader compared with its antero-posterior diameter, and has less elevated tubercles.

"Of the inferior posterior three molars, the last is smallest and very like that of the wolf; the penultimate is next in size, and has an oval crown as in the wolf, but has much less elevated tubercles; and the ante-penultimate which is the longest, in relation to the size of the animal, is much smaller than in the wolf, but it has the same general form; presenting a broad heel behind, worn off flat in the specimen, and three lobes anteriorly, having the same relation to one another, as in the wolf, but more nearly equal in size and forming together more of a triangle."

This brief description is followed by a few measurements of the different elements constituting the type specimens. In the following year[2] Leidy considered his genus *Daphœnus* as a synonym of *Amphicyon* which had previously been proposed by Lartet[3] for the reception of certain remains of canidæ found in the Mio-

[1] Leidy's original spelling of this word was *Daphœnus*, not *Daphænus* as spelled by more recent writers. Since the former is, moreover, the correct latinized form of the Greek *daphoinos*, it has been thought best to retain the original form.

[2] See Proc. Acad. Nat. Sci. Phila., 1854, p. 157.

[3] See Bull. Soc. Geol., 1836, VII., p. 219.

cene formation at Sansans, France. The reference of this material to the genus *Amphicyon* seems to have been based entirely upon the dental formula and is now known to be erroneous, as has been shown by Scott. The chief generic distinctions between *Daphœnus* Leidy and *Amphicyon* Lartet in so far as they are at present known are to be found in the relative size of the premolars, structure of canines, and position of the superior third tubercular molar. The canines of *Daphœnus* are without either anterior or posterior cutting edges, while these are present in *Amphicyon*. The premolars are reduced in size in *Amphicyon*, while those of *Daphœnus* show little or no reduction. In *Daphœnus* the superior third tubercular molar is pushed inward and aligned with the internal cones of the preceding molars, while in *Amphicyon* this tooth occupies a more external position.

In 1869,[4] as *Amphicyon vetus*, Leidy gave a much more complete description of the material which had formed the type of his previously proposed genus *Daphœnus*. Among the more important additional characters then enumerated by him the following may be mentioned as being perhaps of generic importance.

1. Presence of long, strong and high sagittal crest.
2. Auditory bullæ small.
3. M.$\frac{3}{}$ small, transversely oval, with two tubercles and one root.

In 1898[5] Scott confirmed most of the observations made by Leidy and added a great number of new characters relating not only to the skull and dentition, but to other portions of the skeleton as well. In this paper Professor Scott gave the first adequate account of the osteology of the genus *Daphœnus* and pointed out its distinction from *Amphicyon*. On account of the incomplete nature of the material at his command Scott's description was necessarily based on the remains of several more or less fragmentary skeletons belonging to different species. Moreover, as we shall show later, it is not at all certain that some of the material described by Scott does not pertain to a distinct genus.

In 1899 Wortman and Matthew[6] characterized the genus *Daphœnus* Leidy as follows: "Upper molars transversely unsymmetrical (paracone more external than metacone). M$\frac{3}{}$ oval, aligned with inner cusps of anterior molars. Heels of lower molars low-ridged, with low entoconid crest, m$_{\overline{3}}$ a convex nub."

Combining the characters above noted with those shown by the material under discussion, the genus *Daphœnus* may be distinguished by the following cranial and dental characters.

[4] See Journ. Acad. Sci. of Phila., 1869, pp. 31–36.
[5] See Trans. Am. Phil. Soc., Vol. XIX., pp. 325–415.
[6] See Bull. Am. Mus. Nat. Hist., Vol. XII., p. 129.

Dentition $I\frac{3}{3}$, $C\frac{1}{1}$, $P\frac{4}{4}$, $M\frac{3}{3}$; *premolars but little or not at all reduced in size; anterior premolars separated by considerable diastemata; canines stout and without anterior or posterior cutting edge; sagittal crest long and very high throughout its entire length, extending a little in front of temporal constriction; capacity of brain-case very small in proportion to size of skull. Rami of lower jaw not coössified, with inferior border very sinuous and symphysial area much restricted.*

DAPHŒNUS FELINUS Scott.

Specific characters: Scott has distinguished this species as follows:

"The inferior dental series of this species slightly exceeds in length that of *D. vetus* and the sectorial is larger. The lower tubercular molars are inserted in the border of the ascending ramus of the mandible, and, judging from the alveoli, were reduced in size. The horizontal ramus is not much longer, but much heavier than in *D. vetus*, and has a more sinuous ventral border, which rises more beneath the masseteric fossa. The limb bones and vertebræ are somewhat larger and heavier than in *D. vetus*, and the neural spines of the lumbar vertebræ are very high and inclined strongly forward. In size *D. felinus* is the largest and most massive species of the genus."

Among the material in our collections secured by Mr. Peterson are portions of two skeletons, Nos. 492 and 553, which I have referred to this species, although they do not in all respects agree with the characters mentioned above. This is especially applicable to the position of the lower tubercular molars, which in *D. felinus*, according to Scott, are inserted in the border of the ascending ramus. In No. 492 both rami are well preserved, and one of these teeth is still in situ, but its position is in the horizontal ramus rather than the ascending, as is well shown in Pl. XVI., Fig. 2. I do not, however, consider this difference as of specific importance, since, on actual comparison, our material, in other respects, agrees remarkably well with the type. While belonging to a slightly smaller individual it is decidedly larger than the type of *D. vetus*, and differs from the latter in a number of important characters.

THE DENTAL AND OSTEOLOGICAL CHARACTERS OF DAPHŒNUS FELINUS Scott.

The following description of the dental and osteological characters of *D. felinus* is based on the following material, belonging to the collections of this Museum.

No. 492, consisting of a nearly complete skull with lower jaw, atlas, 12 dorsals,

6 lumbars, 15 caudals, 5 sternals, a nearly complete set of ribs, left humerus, radius, ulna and pyramidal, right humerus, radius, ulna and manus except the pyramidal, both hind limbs and feet, and the patellæ and os penis.

No. 553, consisting of a skull without the lower jaw, much injured posteriorly on the right side, with P. $\frac{2}{}$, $\frac{3}{}$, $\frac{4}{}$ and M. $\frac{1}{}$, $\frac{2}{}$ in excellent preservation. Associated with this skull there were found a calcaneum, two caudals, and a few other fragments. Both specimens are from the Oreodon beds on Bad Land Creek, Sioux Co., Neb. Unless otherwise stated the following description will be based on No. 492.

THE SKULL, PL. XIV., FIGS. 1 AND 3, PL. XVI., FIG. 5.

Seen from the side the skull of *D. felinus* is low, with the facial region much abbreviated and the fronto-parietal region somewhat elongated. The distance from the anterior margin of the orbits to the extreme front of the premaxillaries is only about one third the total length of the skull.

Viewed from above the brain-case appears narrow and the zygomata widely expanded. The maximum temporal constriction is a little in advance of the point where the superciliary ridges unite to form the high sagittal crest. The fronto-maxillary region is broad but converges rapidly in front. There is a slight constriction posterior to the canines.

The premaxillaries are small, with rather deep external lateral grooves for the reception of the inferior canines. The incisive alveolar border is placed nearly at right angles to the longer axis of the skull. Posteriorly the premaxillaries send back slender processes which are intruded between the anterior portions of the maxillaries and nasals, but are widely separated by those bones from the anterior projection of the frontals.

The nasals are rather broad anteriorly but narrowed posteriorly. They are extended far back between the frontals.

The maxillaries are very broad posteriorly but narrow anteriorly. They are in contact with the nasals throughout about one half the length of the latter. They are excluded from the anterior border of the orbits by the malars and lachrymals. Inferiorly the maxillo-premaxillary suture bisects the alveolus of the canine. The infraorbital foramen is large and is situated immediately above the anterior portion of the superior sectorial and the posterior portion of P. $\frac{3}{}$. The maxillaries are continued posteriorly to form the floor of the orbits and give support to the superior molars.

The malar forms much the larger portion of the anterior and inferior border of the orbits and sends backward a rather long process which unites, by an extended

suture, with the zygomatic process of the squamosal to form the rather slender, but widely expanded, zygomatic arch.[7]

On account of the old age of both the animals to which our skulls belonged it is impossible to determine the exact character of the lachrymals. They are seen, however, to form a very small portion of the anterior border of the orbits.

The frontals are broad and convex transversely, indicating the presence of quite capacious frontal sinuses. Anteriorly they are separated for a considerable portion of their length by the nasals. Posteriorly and superiorly they display rather rugose superciliary ridges. These converge quite rapidly and unite to form the extremely

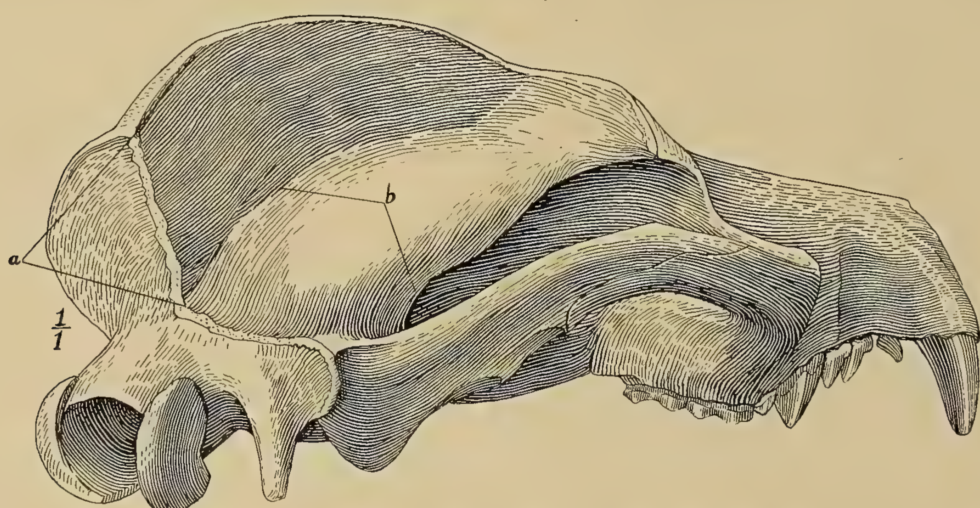


Fig 1. Skull of *Daphænus felinus* Scott, with occipital crest removed from right side to show the great development of sagittal and occipital crests ; *a*, superior and inferior limits of sagittal and occipital crests ; *b*, superior and inferior borders of brain-case. Natural size but foreshortened. (No. 492.)

high and sharp sagittal crest, which is more prominent than in any recent carnivore known to the present writer.

The sutures of the cranial region are so obliterated by age in both individuals that it is impossible to determine the relations of the different elements of this region. Posteriorly the sagittal crest expands into an extremely high and sharp occipital crest which overhangs the occipital condyles. By this unusual development of the sagittal and occipital crests the capacity of the brain-case is reduced to a minimum. The relative development of these crests as compared with the capacity of the brain-case in *Daphænus* is comparable only with that which obtains in Didelphys among recent mammals or in some of the Oligocene Elotheres and Hyænodons.

[7] The zygomatic arches in Daphœnus have been generally described as robust, but they are well preserved in the present specimens and I find them more slender than in modern canines of equal size.

This extraordinary development of the sagittal crest at the expense of the capacity of the brain-case in *Daphœnus* will perhaps prove to be the most distinctive character of the genus. It is well shown in Pl. XIV., Fig. 2, and in Fig. 1 of the text.

The condyles are not entirely complete in either skull. They appear to have been subelliptical in outline with the vertical diameter the longer.

The foramen magnum has the transverse diameter exceeding the vertical, a character which from the material at my command seems to be remarkably constant with the thoöid members of the canidæ, while in the alopecoid series the reverse seems to be the case.

The zygomatic process of the squamosal extends abruptly from the side of the skull nearly at right angles to the longer diameter of the latter, then bends forward and upward so as to overlap the zygomatic process of the malar.

The temporal constriction is very pronounced and the transverse diameter of the cranium at this point is only a little more than one fourth the greatest expanse of the zygomata and one half that of the cranium proper at its widest point between the zygomatic processes of the squamosals.

The palate is broad posteriorly, but narrow in front, and slightly constricted between P. $\frac{1\,\&\,2}{}$. Owing to age the sutures between the palatines and maxillaries are not very distinct. The latter bones appear however to form a more considerable portion of the surface of the palate than do the former, while the extreme anterior portion is formed by the premaxillaries. The anterior palatine foramen is moderately large and is enclosed by the premaxillary except postero-externally, where it is bounded by the maxillary. Owing to the imperfect nature of the specimen it is impossible to determine with accuracy the number or nature of the posterior palatine foramina. The posterior border of the posterior nares is a little behind the last tubercular molar as indicated by the alveolus of that tooth.

The pterygoids are long and curve inwards inferiorly so as to partially enclose the posterior portion of the narial orifice. The hamular processes have been broken away and the condition and age of the specimens do not permit of determining to what extent the palatines and alisphenoids respectively enter into the formation of the pterygoids.

The sutures between presphenoid, basisphenoid, and basioccipital are closed and these bones are all fused as one.

The paroccipital process is slender, styliform, and directed downward and somewhat backward. The mastoid process is low, broad, and separated from the postglenoid process by a wide and deep groove very similar to that which obtains in the modern canidæ, and it doubtless served as in the latter to accommodate the tubular

process of the auditory bulla which enclosed the *external auditory meatus*. The postglenoid process curves slightly forward and overhangs somewhat the glenoid cavity, though not to so great an extent as in the modern wolves. The character of this process is intermediate between that of the modern cats and dogs. The anterior border of the glenoid cavity is flat as in the dogs rather than depressed as in the cats, so that the articulation of the lower jaw is dog-like in nature rather than feline.

Leidy and Scott have both described the auditory bulla of *Daphœnus* as being exceedingly small, though both express some doubt as to the homology of the elements which they have described as auditory bullæ. The following quotation from Scott sets forth the chief characters as described by each of these authors. He says : "The auditory bulla of *Daphænus* is very remarkable and differs from that of any other known carnivore. Its principal characters were observed and noted by Leidy, but the material at his command was insufficient to enable him to describe these peculiarities with confidence. The *tympanic* is exceedingly small and is but slightly inflated into an inconspicuous bulla, the anterior third of which is quite flat and narrows forward to a point. There is no tubular auditory meatus, the external opening into the bulla being a mere hole, but the anterior lip of this opening is drawn out into a short process, somewhat as in existing dogs. Behind the bulla is a large reniform vacuity or fossa of which Leidy remarks: 'At first, it appeared to me as if this fossa had been enclosed with an auditory bulla and what I have described as the latter was a peculiarly modified auditory process.' Several specimens representing both the White River and John Day species of *Daphænus* show that the fossa is normal and was either not enclosed in bone, or, what seems less probable, that the bony capsule was so loosely attached that it invariably became separated from the skull on fossilization, . . ."

After a careful examination of our material and after comparing it closely with the skulls of recent dogs, I am convinced that those elements which have been described by Leidy and Scott as auditory bullæ are in fact that portion of the petrosal enclosing the cavity of the internal ear, while in each instance the auditory bulla has been lost, as from the above quotation it will be seen that both these authors had suspected. Not only do the backwardly projecting paroccipitals, and widely separated mastoid and postglenoid processes indicate the presence of a moderately developed if not large auditory bulla, but on the inner portion of the squamosals and external surfaces of the basiphenoid may be seen marks of the sutures by which they were once loosely attached to these bones. Moreover if we remove the auditory bulla, as may easily be done, in the skull of any recent dog so as to expose

that portion of the petrosal enclosing the cavity of the internal ear, as shown on the left side in Fig. 2, we shall find a very close similarity between that structure and that which has been described by Leidy and Scott as the auditory bulla. The minute external opening described by Scott is no doubt the *fenestra rotunda* of the petrosal and not the external opening to the auditory bulla. The reniform fossa noted by Leidy is present also on the postero-internal side of the petrosal, though not so pronounced in recent species of Canis. Not only do all these and many other characters go to show that this element is in reality the petrosal, but a fragment of the tympanic has been retained in skull No. 492 and is shown in position and overlying the petrosal in Fig. 3. A careful comparison of Figs. 2 and 3 will make it

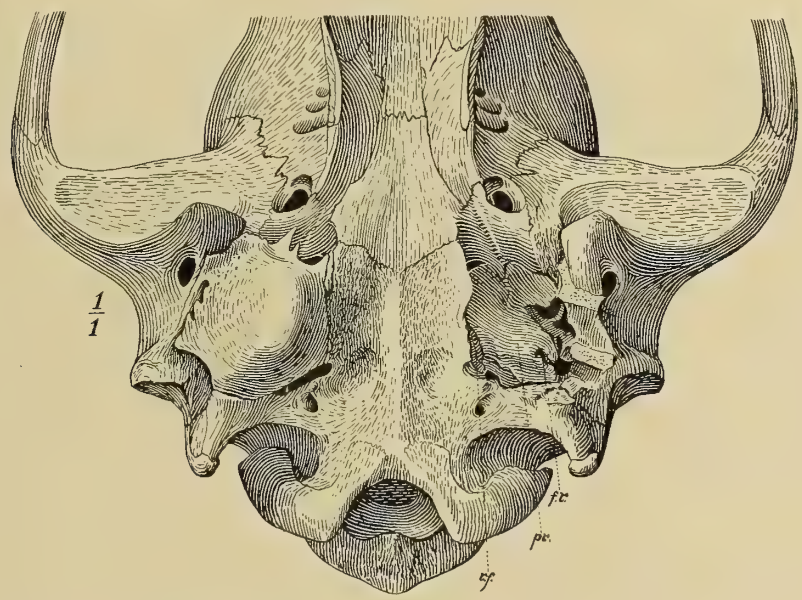


FIG. 2. Inferior view of basicranial region of skull of *Canis familiaris* with auditory bulla removed from left side to show structure of inner ear for comparison with Fig. 3; *r.f.*, reniform fossa; *pr.*, promotory; *f.r.*, fenestra rotunda.

apparent that the bone in question is the petrosal and that through imperfect connection with the surrounding elements the auditory bullæ have very generally been entirely lost in *Daphœnus* during the process of fossilization. Considering this in connection with the fact that in several species of recent dogs, even in adults, the auditory bullæ are easily detached, this may be considered as a primitive condition among the canidæ, while the completely ossified and firmly ankylosed auditory bullæ should be regarded as more specialized characters.

The petrosal therefore is the element which has been mistaken by Leidy and Scott for the auditory bulla. It is proportionately smaller than in the modern

canidæ and in general form it resembles more nearly that which obtains in the felidæ than in the canidæ. Seen from below the general shape of the *promontory* is pyriform with the expanded end directed posteriorly and externally and the apex looking anteriorly and internally. The inferior surface of the *promontory* is convex in all directions as in the cats and not so much flattened as in the modern dogs. The *fenestra rotunda* opens downward, outward and backward, and is more canine than feline in character. The foramen or *fenestra ovalis* looks directly outward toward the groove between the post-glenoid and mastoid processes, but is situated

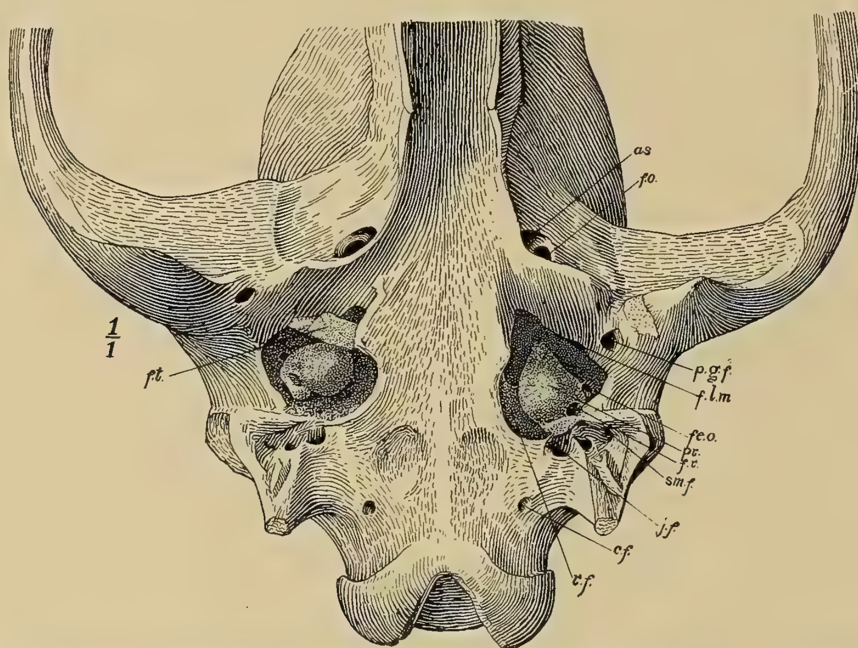


FIG. 3. Inferior view of basicranial region of skull of *Daphœnus felinus* (No. 492). *f.t.*, fragment of tympanic; *as.*, posterior opening of alisphenoid canal; *f.o.*, foramen ovale; *p.g.f.*, postglenoid foramen; *f.l.m.*, foramen lacerum medium; *fe.o.*, fenestra ovalis; *pr.*, promontory; *f.r.*, fenestra rotunda; *sm.f.*, stylomastoid foramen; *j.f.*, jugular foramen; *c.f.*, condylar foramen; *r.f.*, reniform fossa.

high above the roof of that groove. The inflated nature of the *promontory* indicates that the cavity of the internal ear was capacious and the cochlea correspondingly well developed.

In neither of our skulls is the basicranial region sufficiently well preserved to determine with certainty the position or character of all the foramina of this region. In No. 492, however, the following foramina may still be detected and are shown in Fig. 3. The *condylar foramen* perforates the exoccipital at the usual place just within the base of the paroccipital process. The *foramen lacerum posterius* occupied a position on the postero-internal side of the auditory bulla. The *postglenoid fora-*

men lies at the postero-internal base of the postglenoid process. The *foramen lacerum medium* was situated at the antero-internal angle of the auditory bulla. The *foramen ovale* and posterior opening of the *alisphenoid* canal were a little less separated than in modern dogs and opened by a single rather elongate and oval aperture situated external to the posterior extremity of the pterygoid. The *alisphenoid* canal appears to have been small, but long, so that its *anterior opening*, the sphenoidal fissure and the *optic foramen* are crowded close together and all occupy a comparatively small space at the base of the pterygoids.

Measurements (No. 492).

Greatest length of skull	205 mm.
Greatest expanse of zygomata, distortion eliminated	119 "
Length of sagittal crest	95 "
Height of sagittal crest at point of union with occipital crest	28 "
Height of sagittal crest above greatest expanse of brain-case	16 "
Length of zygoma	93 "
Breadth of cranium at point of greatest constriction	31 "
Greatest breadth of cranium	58 "
Expanse of frontals at postorbital processes	43 "

The Mandible, Pl. XIV., Fig. 2; Pl. XVI., Figs. 2 and 4.

The lower jaw is not unusually heavy for a dog of the size indicated by the skeleton. The horizontal ramus is perhaps a little deeper than in modern wolves of the same size, but no thicker. The rami are not coössified. The inferior border is very sinuous and posteriorly it is produced into a slender and hooked angular process. The coronoid process is remarkably broad, thin posteriorly and superiorly, but much thickened quite to the summit anteriorly. The condyle is situated slightly above the alveolar border. It is subcylindrical, and with the articular surface, broad internally and narrow externally. This surface looks backward rather than upward when the jaw is held in a horizontal position. The masseteric fossa is deep and broad. Anteriorly, inferiorly and posteriorly, it is bounded by prominent ridges of bone, developed on the anterior border of the ascending ramus, the postero-inferior border of the horizontal ramus, and that portion of the posterior border of the ascending ramus which gives support to the external portion of the condyle. There are two *mental foramina* situated about midway between the superior and inferior borders of the ramus. One of these, the anterior, is located directly below the anterior root of $P._{\overline{2}}$, while the posterior lies below the same root of $P._{\overline{3}}$. The *inferior dental foramen* is placed near the inferior border and midway between the angle of the ramus and the last tubercular molar.

Measurements.

Length from condyle to incisive alveolar border	152 mm.
Height of condyle above angular process	30 "
" " coronoid " " "	68 "
Width of coronoid at summit	26 "
Depth of ramus below middle of sectorial	26 "
" " ramus below $P._{\overline{1}}$	21 "

The Teeth.

The dental formula is I. $\frac{3}{3}$, C. $\frac{1}{1}$, P. $\frac{4}{4}$, M. $\frac{3}{3}$ — 44. All the teeth are represented in our specimens and in good preservation except the incisors, $P.^{\underline{1}}$ and $_{\overline{2}}$ and $M.^{\underline{3}}$, these are shown only by the alveoli or roots in either jaw of our skulls. By mistake the superior incisors and $P.^{\underline{1}}$ were shaded in from a third skull belonging to a distinct species in the drawing reproduced in Plate XVI., Fig. 5.

Superior Dentition.—Pl. XVI., Fig. 5. The incisive alveolar border extends nearly at right angles to the longer axis of the skull. Only the roots of the incisors are preserved. These show that $I.^{\underline{1}}$ and $^{\underline{2}}$ were small, very much compressed laterally and subequal in size, while $I.^{\underline{3}}$, although small as compared with the same tooth in recent dogs, was much stronger than the two preceding teeth, a character not shown in the illustration, which is erroneous in that respect. Between $I.^{\underline{3}}$ and the canine there is in the premaxillary a deep depression into which fitted the point of the inferior canine.

The canines are blunt, stout, and without anterior or posterior serrated or cutting edges. They are fixed in the jaw by large fangs and are directed downward, forward and outward.

$P.^{\underline{1}}$ is represented only by the fang. It was fixed in the jaw by only a single root and its crown was probably not very different from that shown in the drawing. It was separated from the canine and from $P.^{\underline{2}}$ by considerable diastemata.

$P.^{\underline{2}}$ has two roots and a single median cusp. The transverse diameters of the anterior and posterior portions of the crown are subequal. Its longer diameter is parallel with that of the skull. A short diastema separates this tooth from the succeeding premolar.

The crown of $P.^{\underline{3}}$ supports a single median cusp with a low, broad heel posteriorly and a much narrower anterior portion. There is a rather well-defined basal cingulum along the internal and posterior borders of this tooth. There is no diastema between $P.^{\underline{3}}$ and the superior sectorial. At the anterior margin of $P.^{\underline{4}}$ the alveolar border assumes a direction somewhat oblique to that of the longer axis of the skull which allows the palate to broaden posteriorly.

The sectorial, or P.$\frac{4}{}$, is exceptionally well preserved on the right side in No. 553. In form and structure it much resembles the same tooth in *Canis urostictus*, though it is proportionately a little longer antero-posteriorly than in that species and is thus a little more specialized perhaps than in that species. I think Professor Scott has somewhat exaggerated the primitive characters of this tooth, for aside from its general resemblance to that tooth in the species just cited I note that the antero-external cone as well as the posterior is quite as trenchant as in certain modern species, *Canis cancrivorus* for instance; while the antero-internal cone is proportionately no more prominent than in *Canis azaræ*, *C. lagopus*, *C. vulpes*, or certain varieties of *C. familiaris*. If we compare this tooth with that of *Prodaphænus scottii*, a supposed ancestral form known from a single series of teeth discovered by the present writer in the Uinta beds of northeastern Utah, the comparatively specialized nature of this tooth in *Daphœnus* becomes even more apparent. The antero-external cone of the sectorial in *Daphœnus* is highly trenchant posteriorly and pushed inward. The antero-internal cusp is small. The posterior cone is small and trenchant. The shear is oblique, a primitive character, as in *Canis cancrivorus* and most of the smaller species of modern dogs, not parallel with the longer axis of the skull as in *C. occidentalis* and the wolves generally. Surrounding the tooth there is a well-defined basal cingulum. In Fig. 4, *a*, *b*, *c* represent the superior sectorials respectively of *Prodaphænus scottii*; *Daphœnus felinus* (No. 553) and *Canis lagopus*. The comparative degree of specialization of that tooth in *Daphœnus* is well shown in these figures.

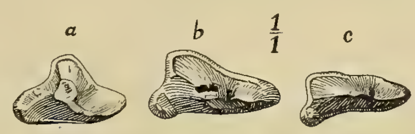


FIG. 4. Crown view of right superior sectorials of; *a*, *Prodaphænus scottii* W. & M. after W. & M.; *b*, *Daphœnus felinus* (No. 553); *c*, *Canis lagopus*. All natural size.

M.$\frac{1}{}$ is exceptionally well preserved on both sides in skull No. 553, it is completely surrounded by a basal cingulum which is least distinct on the anterior border. The crown of this tooth is subtriangular in outline and supports three well defined cones of which two are external and one internal. The two external cones are conical in shape, subequal in size and situated well within the basal cingulum. The internal cone is crescentic in form and there is a faint indication of an anterior intermediate cone between it and the antero-external cusp. The molars of the opposite sides converge posteriorly so that the palate is widest between the posterior borders of the sectorials.

M.$\frac{2}{}$ is much smaller than M.$\frac{1}{}$, but has the same general pattern except that the external cones are situated nearer the outer margin of the tooth and the posterior is much smaller than the anterior.

M.$\frac{3}{}$ is represented only by the alveolus, which indicates that this tooth was small and not functional.

Measurements.

Length of premolar-molar series from base of canine	76 mm.
Length of molar series	38 "
Fore and aft diameter of canine at base	12 "
Transverse diameter of canine	9 "
Length of sectorial (No. 553)	16 "
Width of anterior portion of sectorial (No. 553)	10 "
Antero-posterior diameter of M.$^{\underline{1}}$ (No. 553)	11 "
Greatest transverse diameter of M.$^{\underline{1}}$ (No. 553)	17 "

Inferior Dentition.—With the exception of the incisors and P.$_{\overline{2}}$ all the lower teeth are well preserved on one side or the other in No. 492. Neither the incisors nor their alveoli are preserved in our material, so that in giving the dental formula I have followed Leidy and Scott as to the number of lower incisors. The canines like those of the upper jaw are stout and without cutting edges. P.$_{\overline{1}}$ is a very small tooth fixed in the jaw by only one root, which is directed obliquely backward. There is a rather high cusp on the anterior portion of the crown of this tooth. P.$_{\overline{1}}$ is separated from the canine and the succeeding premolar by considerable diastemata. P.$_{\overline{2}}$ is represented by only the fangs. P.$_{\overline{3}}$ is separated from the preceding tooth by a short diastema, but is in contact with P.$_{\overline{4}}$. It bears a single median cone and has the posterior portion somewhat stronger than the anterior. There is a faint indication of a basal cingulum about the posterior border. P.$_{\overline{4}}$ is in contact with P.$_{\overline{3}}$ and M.$_{\overline{1}}$. It bears a prominent median cone and a well-defined posterior conule. There is a basal cingulum about the postero-external border of this tooth and the heel is considerably broader than the anterior portion, a character not well shown in the drawing reproduced in Pl. XVI., Fig. 4. The sectorial is well preserved in either ramus. The trigon is high and the heel low and flat. The external cusp of the trigon is much the highest and most prominent of the three, while the internal and anterior are of equal height, although the latter is much the stronger of the two. The external cusp of the talon is low and broad while the internal is faint or obsolete. There is an external basal cingulum. The crown of M.$_{\overline{2}}$, as shown in Fig. 5, has the same general pattern as the sectorial except that the trigon is much lower. As in that tooth there are three anterior cones forming a low trigon and a single posterior cone on the heel. The last mentioned cone occupies a more median position than does the corresponding cone of the sectorial, while the trigon is much lower and the cusps forming it are all of equal height, though the external is much stronger than the internal and anterior. M.$_{\overline{3}}$ is a convex rounded nub with a low central cone and a slightly elevated posterior cingulum.


$\frac{1}{1}$

Fig. 5. Crown view of right M.$_{\overline{2}}$ of *Daphœnus felinus* (No. 492).

Measurements.

Length of premolar-molar series from alveolar border of canine	83	mm.
Length of molar series	32	"
Antero-posterior diameter of sectorial	17	"
" " " " canine	12	"
Transverse diameter of canine	8.5	"

Summary of Cranial and Dental Characters.

From the above description and the accompanying figures it will readily appear that the character of the skull, mandible and dentition of *Daphœnus* is essentially canine, and although possessing a number of creodont characters, more especially in the skull, on the whole it is not very different from that which we might expect among representatives of the Oligocene canidæ. I fail to recognize those resemblances between the skull of *Daphœnus* and that of the early *Machairodonts* referred to by Scott. On the other hand all the creodont characters noted by Scott are confirmed in our material, and in addition I may mention the following:

1. The unusual development of the sagittal and occipital crests, which is even more marked than in Hyænodon. Owing to the imperfect nature of the material at his command Scott erroneously described the sagittal crest in *Daphœnus* as being low, it is in fact extremely high and sharp, as shown in Fig. 1.

2. The widely separated premaxillaries and frontals.

3. The incurved pterygoids, which show a tendency to arch over the posterior narial tract inferiorly as is completely done by these bones in Hyænodon.

4. The imperfect development of the auditory bulla.

5. The nearly horizontal zygomata, which are but slightly arched vertically. The orbit however is more widely open posteriorly than in most modern canidæ, and the prominently developed and deflected postorbital process of the frontals seen in *Hyænodon* are only very moderately developed in *Daphœnus.*

The angular process and general conformation of the mandible as well as the limited area of the symphysial surface by which the rami are imperfectly united are essentially canine rather than feline or creodont.

While the dentition is as a whole undoubtedly more primitive than that of any single living species of dog, I do not recall any single character which could be regarded as primitive that is not paralleled or surpassed in some of the recent dogs. The character of the sectorials is very like that of those teeth in *Canis urostictus,* as has already been remarked, and is less primitive than obtains in *C. parvidens.* The dental formula, though normal for heterodont mammals, is surpassed by Otocyon,

while according to Mivart *C. cancrivorus* has been known to develop the same dental formula as *Daphœnus.*

The Vertebral Column.

C. 7; D. 13?; L. 7?; S. 3; C. 23?.

Unfortunately the vertebral column was not sufficiently well preserved to permit of an accurate determination of the vertebral formula, though the principal characters of the vertebræ of the different regions, except in the sacrum and cervicals, are well shown.

The Cervicals.—Pl. XVII., Figs. 1, 2, 3. Of the cervicals only the atlas is preserved and it lacks the transverse processes and a portion of the neural arch, but is otherwise in an excellent state of preservation. It does not differ essentially from that vertebra as described by Scott in *Daphœnus vetus,* except that the articular surfaces for the axis are inclined to the fore and aft axis of the vertebra at an angle of about 45°. As noted by Scott, the vertebrarterial canal perforates the base of the transverse process horizontally as in the cats, and not vertically as in the modern dogs.

The Dorsals.—Pl. XVII., Figs., 4, 5. Save the first vertebra the complete dorsal series is represented in our skeleton, though they are all somewhat injured, and in none is the neural spine complete. Compared with the skull and the lumbars the dorsals seem small and the dorsal region as a whole somewhat abbreviated. The transverse processes are robust and the neural arches and spines slope rather abruptly backward from the first to the ninth. Dorsal eleven is the transitional or anticlinal vertebra. The entire length of the dorsal series is 380 mm.

The Lumbars.—Pl. XVII., Figs. 13, 14, 15. All the lumbars are represented in our skeleton except the sixth, assuming that there were present in the skeleton seven lumbars, which is the normal number in the canidæ. The first lumbar has a well developed anapophysis which points directly backward and a little outward. The transverse processes are rather slender and are directed downward, forward and outward as in the cats, instead of being directed horizontally forward as in the dogs and bears. Compared with the dorsals the lumbars are long and heavy.

The Sacrum.—This is not represented in our skeleton, but in the Princeton material it is shown to be composed of three vertebræ.

The Caudals.—Pl. XVII., Figs. 6–12. Fifteen caudals are preserved in our skeleton. Fortunately most of these are in a good state of preservation and give a fair idea of the different regions of the tail. They indicate that this appendage was long and intermediate in character between the cats and creodonts, being somewhat

longer than is usual in the former, but absolutely and proportionately shorter than in the creodonts, Patriofelis and Hyænodon.

The most anterior vertebra of our series of caudals I regard as the first. It is short and stout, with widely expanded anterior zygapophyses bearing well developed metapophyses. The transverse processes are single, widely expanded both transversely and antero-posteriorly. They are directed outward and backward and support a considerable median prominence on the anterior edge. The top of the neural spine is wanting, but the base indicates that this process was fairly well developed. The above mentioned characters are all well shown in Plate XVII., Figs. 6 and 7. For an anterior caudal it very closely resembles that vertebra in Hoplophoneus, one of the Oligocene saber-toothed cats. But among recent carnivores it is decidedly more canine than feline in character.

I will next describe that caudal in our series which I regard as the fifth. It is shown in Plate XVII., Fig. 8. The posterior zygapophyses extend well beyond the posterior end of the centrum. The posterior transverse processes point strongly backward and outward and bear a rather prominent rugosity on the superior surface and near the external border. This vertebra is just commencing to develop an anterior transverse process and articulations for the chevrons.

The next vertebra, Plate XVII., Fig. 9, to be described from our series, appears to be the seventh caudal. In this vertebra the anterior transverse processes are well developed, being equal in expanse although more slender than the posterior. The metapophyses continue as well developed expansions of the anterior zygapophyses. There is a large foramen at the base and just in front of the posterior zygapophyses not shown in the figure.

The next vertebra to be described in our series I regard as the ninth caudal. It is shown in Pl. XVII., Fig. 10. In this vertebra the anterior of the transverse processes have become the stronger and are directed forward and outward instead of directly outward. The development of the anterior transverse process of the caudals of this region is much more marked in *Daphœnus* than in most modern dogs and cats, and is quite unlike that which obtains in *Hoplophoneus.* This vertebra bears on the inferior surface at its anterior extremity very prominent rugosities for the attachment of chevrons.

Between the supposed ninth and the next vertebra represented in our series a number of caudals are missing. I have estimated the number at three. This would make the vertebra represented in Fig. 11, Pl. XVII., the thirteenth. In this vertebra the neural canal has already become obsolete, the anterior and posterior zygapophyses are reduced to mere prominences, as are also the ante-

rior and posterior transverse processes. The rugosities for the chevrons continue prominent.

Of the remaining caudals all are represented in our series but the sixteenth and one or more of the distals. The twenty-first is shown in Fig. 12, Pl. XVII. It is reduced to a slender rod of bone and is evidently from near the posterior extremity of the tail. There is only one smaller in our series.

Measurements.

Length of centrum of first? caudal	19 mm.
Expanse of transverse process of same vertebra	61 "
Length of centrum of fifth? caudal	35 "
" " " " seventh? caudal	40 "
" " " " ninth? "	44 "
" " " " thirteenth? caudal	44 "

The Sternum, Pl. XVIII., Fig. 1.

The sternum in our skeleton is represented by five of the mesosterni. I have interpreted these as the anterior. Assuming that there were present in the sternum of *Daphœnus* six mesosterni, the normal number alike in the canidæ and felidæ, there is wanting but one of these bones. This, together with the presternum and xiphisternum, both of which are wanting in our skeleton, would complete the sternal series. These bones are rather more slender than in recent dogs of the same size, but they are of the same general character. Their combined length is 132 mm.

The Os Penis, Pl. XVIII., Figs. 4, 5.

Daphœnus, as well as *Cynodictis*, was possessed of a remarkably well developed and highly specialized os penis, even surpassing that which obtains in the modern raccoons. As regards the development of this bone *Daphœnus* was preëminently canine rather than feline in character.

The os penis, throughout the proximal two thirds of its length, is elliptical in cross-section with the greater diameter directed vertically. Proximally, it is much compressed into a flattened, wedge-shaped, very rugose extremity, for muscular attachment to the pubes. Distally, this bone becomes more cylindrical in cross-section, and at about the middle of its length a shallow groove appears on its inferior surface. This gradually becomes more pronounced, giving rise anteriorly to a deep channel, and at a distance of 10 mm. from the extremity the bone is entirely bisected, and sends forward the two peculiar spout-like processes shown in Fig. 5, Pl. XVIII., each with a shallow groove on its internal surface.

In *Cynodictis* this bone is grooved throughout nearly its entire length. The distal extremity is not bifurcated as in *Daphœnus*, but is solid, abruptly curved, and terminates in much the same manner as in *Procyon lotor*. The dimensions of these bones in *Daphœnus* and *Cynodictis* are as follows:

Length of os penis in Daphœnus	166	mm.
" " " " Cynodictis	120	"
Depth of os penis in Daphœnus at proximal end	16	"
" " " " Cynodictis " "	9	"

The Ribs.

Most of the ribs are represented and several are quite complete. The anterior are short but proportionately very stout. Throughout the series they are shorter than in most modern dogs, with limbs of equal length, thus indicating a body cavity of relatively small capacity. The greatest length of the best preserved ribs measured along the cords of the arcs formed by the bones is as follows:

First	45	mm.
Second	58	"
Third	83	"
Fourth	98	"
Sixth	105	"
Seventh	119	"
Ninth	123	"
Tenth	120	"

The Fore Limbs and Feet.

Unfortunately the scapulæ are wanting in our skeleton and I am unable to give the characters of this important bone.

The Humerus.—Pl. XIX., Figs. 7, 7ª and 8. Both humeri are preserved in our skeleton and are nearly complete, though much crushed. They are decidedly more cat-like than canine. In fact almost every character by which one could with reasonable certainty distinguish a modern feline humerus from that bone in the canidæ is present, and were the humerus of *Daphœnus* found isolated one would unhesitatingly refer it to some member of the felidæ, thus showing how unreliable a guide the comparative osteology of recent vertebrates may be to the student of vertebrate paleontology. There is a large *supra-condyloid foramen* bounded internally by a strong supra-condylar ridge, a character always found in the modern felidæ and which would alone distinguish the humerus of a cat from a dog. There is no *supra-trochlear foramen*, but the anconeal fossa is deep. The external *supinator ridge* is developed into a broad and sharp ridge of bone ex-

tending throughout about one third the total length of the shaft. Superiorly this ridge shows a much greater development than in either the modern felidæ or canidæ. The articular surface of the radial condyle is more distinctly keeled than in the felidæ and in this respect is more canine in character. A very sharp ridge continues upward from this keel along the posterior side of the bone and along the external margin of the anconeal fossa. The ulnar condyle is somewhat intermediate between that which obtains in the modern canidæ and felidæ. Proximally the deltoid ridge is only moderately developed. The bicipital groove is deep as in the dogs, the head is subelliptical in outline with the greater tuberosity much exceeding the lesser in size.

The Radius and Ulna. — Pl. XIX., Figs. 9–12. Both radii are present and in good condition. The most remarkable feature of the bones of the forearm is their diminutive length as compared not only with the humerus, but with the same bones in modern canidæ and felidæ, more especially the former. While the lengths of the humerus and radius in the present skeleton are respectively 185 mm. and 135 mm., the latter being therefore a little more than one fourth shorter than the former I note that the relative lengths of these bones in *Felis tigris* and the retriever dog are respectively 270 mm. and 240 mm. and 183 mm. and 205 mm. Thus we see that in the tiger the radius is only one ninth shorter than the humerus, while in the dog it is nearly one eighth longer than the humerus. In *Canis latrans* the lengths of these bones are 157 mm. for the humerus and 163 mm. for the radius, the radius being still somewhat longer than the humerus. These bones are not only proportionately shorter than in the canidæ, but they are stouter and more completely crossed than in the dogs. In both these characters they resemble more closely those conditions as found in the cats than in the dogs. The articular surface of the head of the radius for the humerus is regularly concave and rather deeper than in the dogs and suboval in outline. The inner margin of the head is much expanded and overhangs the shaft of the bone as in the cats. Anteriorly there is a small median prominence. The surface for articulation with the lesser sigmoid cavity of the ulna is carried far around on the internal side of the head of the radius by reason of the enlarged coronoid process of the ulna which is feline rather than canine in character. The tubercle of the radius is rather prominent and there is a noticeable constriction between it and the head. On the postero-external side, and in about the middle of the shaft of the radius there is an elongated rugosity which opposes a similar one on the antero-external surface of the ulna. These rugosities served for the muscular attachment of these bones. The distal end of the radius is considerably expanded both antero-posteriorly and transversely and supports a triangular,

shallow, cup-like articular surface for contact with the scapho-lunar. This articular surface is continued far down on the styloid process. There is a rather deep groove for the extensor tendon of the pollex and just above this and on the internal side of each radius is a remarkable exostosis. On the anterior and external surface of the distal end of the radius are to be seen the usual grooves for the extensor tendons of the manus. The articular surface for the distal end of the ulna is nearly circular in outline and occupies the same position as in the cats, being decidedly more inferior than that which obtains in the dogs. The shaft of the radius throughout its entire length is subelliptical in cross-section. The shaft of the ulna is much compressed proximally as in the cats, not trihedral as in the dogs. The olecranon process is broad and higher than in the modern dogs, though perhaps not quite so prominent as in the cats. It may therefore be considered as somewhat intermediate in character between the dogs and cats though decidedly more like the latter. The superior and posterior margins of the olecranon are very rugose and much expanded, indicating the presence of a powerful triceps muscle. The greater sigmoid cavity does not differ much from that which obtains in modern dogs. What little variation there is however is seen in the more extended inferior and internal articular surface, due to the greater development of the coronoid process and is in the direction of the cats. Indeed the entire construction of the elbow and limb is remarkably feline as is seen in the abbreviated forearm, the well-developed coronoid and olecranon processes of the ulna and the presence of a supracondylar foramen in the humerus. Distally the ulna is trihedral in cross-section and there is a moderately developed and flattened styloid process for articulation with the pyramidal and pisiform. On the inner side at the distal end of either radius there is a considerable growth of diseased bone, or exostosis mentioned above. These are remarkably similar on either side as is shown in Pl. XIX.

The Carpus.—Pl. XVIII.; Fig. 10. The carpals of the right manus are all present in our skeleton with the exception of the pyramidal. While that bone is wanting in the right manus it is present in the left, so that it is possible to determine with accuracy the structure of the carpus. The proximal series of carpals consists of the coössified scapho-lunar, the pyramidal and pisiform. In the distal row there are the usual elements, the trapezium, trapezoid, magnum, and unciform.

The scapho-lunar is much the largest bone in the carpus. The two elements of which it is made up are so completely united as to leave no trace of a suture. The radial side is a little more depressed than in canis, while the posteriorly-projecting *radiopalmar process* is reduced as in the cats instead of expanded vertically as in the dogs. Superiorly there is a regularly convex articular surface for articulation with

the radius, while distally there are four well-defined articular surfaces for contact with the trapezium, trapezoid, magnum, and unciform. The scapho-lunar did not articulate laterally with the pyramidal as in the canidæ, but those bones were well separated by the superior, keeled, articular surface of the unciform. The middle, inferior, and anterior surface of the scapho-lunar is produced into a rather extended keel, which is interposed between the trapezoid and external portion of the magnum in such manner as to reduce the antero-internal portion of the latter to a flattened disk, more pronounced even than in the modern felidæ and quite different from that which obtains in the dogs.

The pyramidal is very much flattened, much more so than in either the recent canidæ or felidæ. Inferiorly and posteriorly it is continued into a considerable process which overlaps and gives lateral support to the proximal end of metacarpal V. Inferiorly there is a rather extensive and concave surface for articulation with the unciform. The superior, or external surface, shows two subequal articular surfaces, separated by a low keel for contact with the pisiform and ulna.

The pyramidal and ulnar articular surfaces of the pisiform are subequal and the tuberosity is more expanded than in either the modern canidæ or felidæ.

The trapezium is decidedly heavier than the trapezoid in marked contrast to the relative proportions of those bones in the modern dogs. It presents a broad, flat articular surface for contact with M. I., but scarcely articulated with M. II. thus approximating the dogs rather than the cats.

The trapezoid is a small triangular bone with the apex directed backward. Superiorly it presents to the scapho-lunar an articular surface which is convex anteriorly and concave posteriorly. On the internal side it articulates with the trapezium, while inferiorly and externally it articulates with M. II. and the magnum, which it slightly overlaps as in the cats, though its contact with the latter bone is quite limited. The general shape of the bone is cat-like rather than canine.

The magnum is very much depressed antero-internally, but externally it sends upward a sharp ridge of bone between the unciform and scapho-lunar which posteriorly almost entirely separates those bones. Both these characters are feline rather than canine, but both are more emphasized in *Daphœnus* than in the recent cats, while in the dog the magnum is high in front throughout its entire width and the superior keel or ridge on the supero-external border is less pronounced than in the cats. Distally the magnum presents an articular surface for contact with M. III.

Next to the scapho-lunar the unciform is the largest bone in the carpus. It is wedge-shaped, with the apex directed upward. It articulates internally with the magnum and scapho-lunar, externally with the pyramidal and distally with M. IV.

and V. It is proportionately broader and lower than in the cats. In this respect it approximates more nearly those conditions which obtain in the dogs, but it is much more compressed superiorly than in the dogs, thus resembling the cats. It is, in fact, intermediate in form between that which obtains in the dogs and cats, though approaching somewhat more nearly the latter.

Considered as a whole, the carpus of *Daphœnus* seems remarkably cat-like, but proportionately a little low and broad, the trapezoid and magnum being especially reduced in height. It is, therefore, of quite primitive structure and indicates that *Daphœnus* had not yet acquired cursorial habits.

The Metacarpus.—Pl. XVIII., Fig. 10. In *Daphœnus* the metacarpus is short and broad as compared with that of either the dogs or cats. Metacarpal I. is longer when compared with the other metacarpals than in the recent dogs or cats. Its articulation with the carpus is decidedly feline. It articulates with the trapezium only, the lower portion of that bone being interposed between the proximal ends of Metacarpals I. and II. in such manner as to exclude the former from contact with the latter precisely as in the cats. Metacarpals II., III., IV. and V. are of about equal strength. III. and IV. are the longer and are subequal in length while II. and V. are of about equal length but noticeably shorter than III. and IV. Metacarpals II., III., IV. and V. are closely applied proximally, but somewhat separated distally. The proximal inter-articulation of these bones is much less complicated than in the cats or dogs and they do not so perfectly interlock with one another as in either of the latter, showing that the manus of *Daphœnus* was less perfectly digitigrade than that of recent dogs, though by no means plantigrade. The proximal articulation of these bones with one another is decidedly more canine than feline.

The Phalanges.—Pl. XVIII., Fig. 10. The phalanges are intermediate in character between those of the dogs and cats. Those of the proximal row are somewhat arched as in the cats. The second series are nearly symmetrical as in the dogs, but the distal articular surfaces are less expanded laterally than in the dogs and are continued further back, upon the superior surface, as in the cats, indicating that the terminals were to a certain extent at least retractile. The terminal phalanges are high and very much compressed claws with rudimentary hoods. They are distinctly cat-like rather than canine in character.

Taken as a whole, the forelimb and foot of *Daphœnus* was comparatively short, the forearm and foot especially so. In general, its structure is decidedly feline rather than canine, and this applies alike to the bones of the brachium, the antebrachium and the manus, though there are a few canine characters, more especially

in the structure of the manus and the character of the proximal and second series of phalanges.

Principal Measurements of Fore Limb and Manus.

Greatest length of humerus	185 mm.
" transverse diameter of distal end of humerus	41 "
" length of radius	135 "
" " ulna	171 "
" " ulna below coronoid process	137 "
Height of olecranon above anconeal process	27 "
Antero-posterior diameter of olecranon at summit	22 "
" " ulna just below sigmoid cavity	20 "
Greatest breadth of carpus	34 "
Greatest height of carpus, anterior	12 "
" breadth of scapho-lunar	24 "
" depth of scapho-lunar	10 "
" length of metacarpal I.	25 "
" " " II.	37 "
" " " III.	47 "
" " " IV.	45 "
" " " V.	35 "
Combined length of phalanges of digit I., when in position	29 "
" " " " II., " " "	46 "
" " " " III., " " "	54 "
" " " " IV., " " "	52 "
" " " " V., " " "	45 "

The Hind Leg and Foot.

Unfortunately the pelvis is not preserved in our skeleton. All the bones of either hind leg and foot however are present and in a good state of preservation, with the exception of some three or four phalanges.

The Femur.—Pl. XIX., Figs. 1 and 2. When compared with the humerus, the femur of *Daphœnus* is proportionately a little shorter than in either the dogs or cats. The head is directed more vertical than in either of the latter animals. The depression for the *ligamentum teres* is situated well down toward the lower margin of the articular surface of the head. The neck is constricted and extends inward and upward at an angle of about thirty degrees to the vertical axis of the bone, so that the position of the head is much less horizontal than in recent dogs or cats. The greater trochanter is a little lower than the superior surface of the head. Posteriorly and superiorly it is produced into a sharp ridge which partially encloses the deep digital fossa. Externally it is expanded into a broad, rugose area for muscular attachment. Vertically this rugosity is much more extensive than in modern forms and inferiorly it is continued as a sharp ridge of bone extending along the

posterior external border throughout one half the length of the bone. On the postero-internal margin, just at the base of the neck, there is a conspicuous *lesser trochanter.* There is no third trochanter. Distally the internal and external condyles are subequal and separated by a deep but narrow intercondylar notch. There were present on the external condyles rather prominent fabellæ. The external and internal tuberosities are not prominent and in the middle of the latter there is a deep ligamentary depression, equaling that for the *ligamentum teres.* The trochlea for the patella is broad and shallow as in the cats.

The Patella.—Pl. XIX., Fig. 13. This bone is decidedly feline in character. Its general form is that of an almond, thickened above and wedge-shaped inferiorly. The articular surface is broadly convex transversely and very gently concave vertically.

The Crus.—The crus is in almost every respect more feline than canine in character. This is shown in the length of the bones composing it, which are not only absolutely longer than those of the fore arm, but are proportionately longer when the length of these bones is compared with that of the humerus and femur. But it is in the shape of the fibula and in its relation to the tibia that the most characteristic feline characters are to be found, as will readily appear when we come to describe that bone in detail.

The Tibia.—Pl. XIX., Figs. 3 and 4. The tibia is a little more than one fourth longer than the radius. Proximally it is much expanded both laterally and antero-posteriorly. The surfaces for articulation with the external and internal condyles of the femur are subequal and separated from one another by a rather high median crest. The cnemial ridge is high and long, extending far down on the anterior border, as in the cats, instead of being short as in the dogs. There is a broad articular area on the inferior and outer surface of the external tuberosity for articulation with the fibula. The external and internal tuberosities are much projected posteriorly in such manner as to overhang the shaft of the bone to a much greater degree than that which obtains in the dogs and more nearly resembling those conditions as displayed in the cats. Throughout the proximal two thirds of its length the shaft of the tibia is trihedral in cross-section, distally, however, it is irregularly quadrangular. Throughout one half of its length at the distal extremity the external surface of the tibia is produced into a low sharp ridge, as in the cats, instead of being flattened for contact with the fibula, as in the dogs. In harmony with the above mentioned characters the shafts of the tibia and fibula are widely separated in *Daphœnus* throughout their entire length as in the cats, instead of being closely applied throughout the lower one half of their length as in the dogs. The distal

articulation for the fibula is small. Internally the distal end of the tibia is produced into a broad internal malleolus. The grooves for the flexor tendons are fairly well defined. The ridge separating the external and internal articular surfaces for the astragalus is low as in the cats and the external surface is transversely broader than the internal, though the latter is more extended antero-posteriorly.

The Fibula.—Pl. XIX., Figs. 5 and 6. This bone is cat-like in almost all its characters. The shaft is very slender and much flattened transversely. The proximal end is much expanded, with a deep external concavity embraced between prominent anterior and posterior rugose tuberosities, while on the internal side there is a sharp median ridge extending for an inch below the ovate articular surface for the tibia. For a short distance below the termination of this ridge the shaft becomes a slender, cylindrical rod of bone, circular in cross-section, a little below this its antero-posterior diameter increases and it becomes a flattened bar with the external surface gently convex. Distally the fibula is expanded in both directions. On the postero-inferior angle there is an external malleolus, while just below and a little anterior to this is a prominent tuberosity, as seen in some of the cats, though absent in others and in the dogs generally. A deep groove for the *peroneus longus* is thus formed between this tuberosity and the external malleolus. The articular surface for the tibia is small, that for the astragalus is much larger. On comparing this bone with the fibula of *Hoplophoneus*, a contemporaneous sabre-toothed cat, I note that it resembles more closely that of the modern felines. While the fibula of Hoplophoneus is distinctly feline, yet it bears a certain resemblance to that bone in the creodonts not shown by the fibula in Daphœnus. These resemblances are to be seen in the shorter and more cylindrical shaft and in the rather less expanded extremities.

The Tarsus.—Pl. XVIII., Fig. 9. The tarsus of Daphœnus and indeed the entire pes is decidedly feline rather than canine in structure, and moreover it more closely resembles the pes in modern cats than does the pes of *Hoplophoneus*. All the elements usually found in the tarsus of the carnivora are present.

The calcaneum is comparatively rather short and stout. The tuberosity is more expanded antero-posteriorly than in the modern cats or *Hoplophoneus*. On its anterior surface midway between the summit and the articular surface for the astragalus there is a prominent rugosity. At the apex the internal tuberosity is more elevated than the external and they are separated by a shallow median groove for the *tendon of Achilles*. Compared with modern dogs or cats the inferior portion of the calcaneum is remarkably short and broad. The external articular surface for the astragalus is flat transversely, but very convex supero-inferiorly. It is continued

well up on the antero-internal surface of the tuberosity, as in recent dogs and cats. The *lesser process* or *sustentaculum* is much more expanded than in either the dogs or cats. It bears the internal articular surface for the astragalus. This surface is elliptical in outline. Superiorly it is separated from the external articular surface by a shallow groove for the interosseous ligament, and inferiorly by a rather wide rugose area. The *greater process* is much broader and shorter than in recent dogs and cats and shows no articular surfaces for the neck and head of the astragalus. The *peroneal tubercle* is more prominent than in recent cats and the groove for the *peroneus longus tendon* is deeper. The articular surface for the cuboid is subcircular, regularly concave and looks almost directly downward as in the dogs instead of downward and inward as in the cats. There is a large, rugose tuberosity on the posterior side of the distal end. Owing to the abbreviated nature of the distal portion the calcaneum does not come in contact with the navicular.

The astragalus is feline throughout. The head is much expanded transversely and the neck is even more constricted than in most modern cats. The neck and head are inclined sharply inward from the axis of the trochlea and the head presents an elongated, elliptical articular surface for the navicular, which is convex in all directions. The trochlea is not so convex supero-inferiorly as in the recent canidæ or felidæ, but in other respects it does not differ materially from that surface in the cats. The tibial side is low and narrow, the fibular high and wide, and they are separated by a wide ginglymoid groove which may be a little shallower than in the modern cats, but is decidedly deeper than in *Hoplophoneus*. On the plantar side the external and internal articular surfaces for the calcaneum are separated by a deep, narrow groove for the *interosseous ligament*. These articular surfaces do not differ from the corresponding ones in the astragalus of the cat.

Owing to the abbreviated *greater process* of the calcaneum and the unreduced neck and head of the astragalus the inferior surface of the latter falls below the inferior portion of the calcaneum and comes in contact laterally with the cuboid, a condition which, in so far as I know, does not obtain in either the dogs or cats of the present day, but is to be observed, though to a less extent, in *Hoplophoneus*. By reason of the abbreviated nature of the inferior portion of the calcaneum, which thus allows the cuboid to articulate laterally with the ectocuneiform, the navicular and the head of the astragalus, the cuboid is proportionately elongated in *Daphœnus*. Its superior surface for articulation with the calcaneum is regularly but gently convex. Inferiorly it articulates with metacarpals IV. and V. by a single, slightly concave articular surface. On the internal side there are two articular surfaces for contact with the ectocuneiform, separated by a broad, shallow groove. One of these

is very small and is situated on the lower antero-internal angle, the second and larger is triangular in outline and occupies the antero-median portion of the internal border. On the supero-posterior angle there is a small surface for contact with the navicular, while extending all along the supero-internal border is a surface for the head of the astragalus. On the tibial side there is a well-developed tuberosity running obliquely across the surface of the bone. This is separated from the inferior and dorsal surfaces by a deep groove for the *peroneus longus*. These conditions are just such as obtain in the cat, but quite different from those found in the dog.

The ectocuneiform is in general cat-like, but with a number of distinctive characters. The distal surface is more distinctly concave antero-posteriorly and transversely, and the posterior projection is not so much constricted. On its external side it articulates with the cuboid and metatarsal IV. Internally, besides articulating with the mesocuneiform, it has an extended contact with metatarsal II. Superiorly it articulates with the external one half of the inferior surface of the navicular. The process of the posterior surface is less hooked than in the cats and decidedly more like that of the dogs.

The mesocuneiform is much the smallest bone of the tarsus. It is wedge-shaped with the apex directed posteriorly. Both the superior and inferior surfaces are concave, the former articulates with the navicular, the latter with metatarsal II. Externally it articulates with the superior one half of the internal side of the ectocuneiform, internally with the superior portion of the external surface of the entocuneiform.

The entocuneiform does not differ materially from that bone in recent carnivores. It is elongated vertically and wedge-shaped antero-posteriorly. Externally it articulates with metatarsal II. and the mesocuneiform, proximally with the navicular, and distally it gives support to metatarsal I., which is much less reduced than in the recent dogs and cats.

The navicular in *Daphœnus* is low as in the cats. The superior surface is deeply concave for the reception of the convex head of the astragalus. Inferiorly it articulates with all three of the cuneiforms, but the articular surfaces for each are only indistinctly differentiated. There is a pronounced posterior tuberosity.

The Metatarsus.—Pl. XVIII., Fig. 9. The bones of the metatarsus interlock much more perfectly than do those of the metacarpus. While differing in some of its details from that of the cats, the metatarsus is decidedly feline rather than canine. This is seen in the greater development of the tuberosity of metatarsal V.; in the more produced proximal portion of metatarsal II., so as to articulate or cover throughout one half its length the inner surface of the ectocuneiform, and in the

arched palmar surface of all the metatarsals. In *Daphœnus* metatarsal I. is present and bears two well developed and functional phalanges, thus differing materially from both the recent cats and dogs. The articulation between the proximal ends of the metatarsals and the distal row of tarsals is more complicated than in either the cats or dogs. This is due to a system of "breaking joints" as it were, well shown in the figure. The entocuneiform, besides articulating externally with the mesocuneiform, has a quite extended contact with the internal surface of the proximal end of metatarsal II., while the latter, as already remarked, externally overlaps the lower one half of the internal side of the ectocuneiform. The proximal end of metatarsal IV. rises above metatarsal III. and articulates with the extreme distal, external lateral surface of the ectocuneiform. The distal extremities of the metatarsals are expanded dorsally just above the articular surfaces into prominent rugose tuberosities as in the cats.

The Phalanges.—Pl. XVIII., Fig. 9. The proximal phalanges are arched as in the cats, save that of digit I. which is comparatively straight. The second series of phalanges are less symmetrical than the same series in the manus, and approach more nearly the form assumed by that series in the modern cats. As in the cats the outer border is the thicker, and the distal articular surfaces are directed somewhat externally. The unguals are developed into sharp-pointed, high, compressed, hooded claws, as in the cats, instead of curved cylindrical cones as in the dogs. As in the fore foot the structure of the unguals and second series of phalanges indicates that *Daphœnus* was provided with retractile claws much as the modern cats. There were but two phalanges in the first digit. Taken as a whole the pes of *Daphœnus* was a little shorter and broader than that of the modern cats, and decidedly more so than that of the recent dogs. It was much longer however than in the machairodonts. There were the usual sesamoids, both in the fore and hind feet, but they present no peculiarities and hence need no further description.

Principal Measurements of Hind Leg and Foot.

Greatest length of femur	201	mm.
Expanse of condyles	32	"
Greatest length of patella	21	"
" breadth of patella	16	"
" thickness of patella	8	"
" length of tibia	179	"
Distance from posterior border of external trochlea to summit of cnemial crest	41	"
Transverse diameter of proximal end of tibia	36	"
" " distal end of tibia	28	"
Depth of internal malleolus below internal groove for astragalus	13	"
Length of fibula	168	"

Breadth of fibula at proximal end	22 mm.
" " distal end	16 "
Length of calcaneum	50 "
Height of tuberosity of calcaneum above groove for interosseous ligament	34 "
Depth of greater process below groove for interosseous ligament	16 "
Distance from internal border of lesser process to external border of peroneal tubercle	28 "
Antero-posterior diameter at base of tuberosity	20 "
Greatest length of astragalus	30 "
" breadth of astragalus	21 "
Transverse diameter of head of astragalus	17 "
Distance of head below inferior margin of ginglimoid groove	15 "
Height of cuboid	16 "
" ectocuneiform	11 "
" mesocuneiform	6 "
" entocuneiform	14 "
Depth of navicular	8 "
Transverse diameter of navicular	21 "
Length of metatarsal I	35 "
" " II	49 "
" " III	58 "
" " IV	61 "
" " V	50 "
" phalanges of digit I. in position	33 "
" " " II. "	47 "
" " " III. "	56 "
" " " IV. "	55 "
" " " V. "	47 "

After the above description of the skeleton of *Daphœnus felinus* was written, it was carefully compared with the osteological characters as described by Professor Scott and a number of inharmonious statements were detected relating to those parts of the skeleton preserved in the collections of both museums. A careful reëxamination of our material was then undertaken with the idea of eliminating if possible such inconsistencies. This attempt, however, was only partially successful, for while a number of inaccuracies were found in my first description they were for the most part unimportant and there still remain a number of differences between the description given above and that of Scott. Many of them are doubtless due to the imperfect, fragmentary and scattered condition of the material upon which Professor Scott's description was based, which frequently did not permit of an accurate determination of certain characters.

The Mounted Skeleton. Plate XX.

The skeleton (No. 492) was freed from the matrix with great skill and care by Mr. O. A. Peterson and has been mounted with commendable ingenuity by Mr. A.

S. Goggeshall in such manner that all the different bones may be readily detached for examination and study. The pelvis, sacrum, missing lumbar and cervicals were modeled from material very kindly loaned by Dr. M. S. Farr, Curator of Vertebrate Paleontology at Princeton University. The scapulæ have been modeled in plaster and are purely conjectural, that element in Daphœnus remaining as yet unknown. In modelling the scapula that of the cat has been followed rather than the dog. Since in most skeletal features, aside from the dentition and skull, Daphœnus, as has been shown, is decidedly more cat-like than dog-like.

The general aspect of the articulated skeleton is that of a long, slender-bodied, long-tailed and proportionately short-limbed carnivore. In form and general proportions the appearance of the skeleton is that of a cat with a skull elongated as in the dogs. The limbs are short in proportion to the length of the skull and vertebral column. The lumbar region is especially long and the lumbars exceptionally heavy. The proportion of the axial to the appendicular skeleton is somewhat intermediate between that which obtains in the cats and creodonts.

DAPHŒNUS DODGEI Scott.

In our collections there is a left mandibular ramus (No. 573), which from its massive nature, the character of the dentition and the horizon, Titanotherium beds, in which it was found, I do not hesitate to refer to the above species. The ventral border is hardly so sinuous as that described or figured by Scott, but in almost every other respect it agrees accurately with Scott's description of the type. The teeth are placed more closely than in any of the other species, the premolars being separated from each other and the canine by very short diastemata. The premolars and molars are short but broad and $P._{\overline{3}}$ and $_{\overline{4}}$ have well developed posterior tubercles and basal cingula. $M._{\overline{3}}$ is implanted in the ascending ramus as indicated by the alveolus, the tooth being wanting in the present specimen.

PROAMPHICYON NEBRASCENSIS gen. et sp. nov.

Among the material collected by Mr. Peterson is an imperfectly preserved skull without lower jaw, a side view of which is shown in Fig. 6, which I have reluctantly made the type of a new genus and species. Not only does it differ materially in several important dental characters from any of the White River canidæ yet described, but moreover it presents characters quite distinct from those of *Daphœnus* and somewhat intermediate between those of that genus and of *Amphicyon*, as will be shown later.

Proamphicyon nebrascensis. — *Char. gen.* I.$^{\underline{3}}$, C.$^{\underline{1}}$, P.$^{\underline{4}}$, M.$^{\underline{3}}$. Sagittal and occipital crests very high and sharp. Premolars much reduced in size. Canines long, compressed, elliptical in cross-section and with posterior cutting edge.

Char. sp. Temporal constriction very marked and situated posterior to the anterior extremity of the sagittal crest. Capacity of brain-case much reduced. M.$^{\underline{3}}$ supported by two roots, its position more external than in *Daphœnus.* Shear of superior sectorial a little less oblique than in most other Oligocene canidæ. Internal cone of sectorial reduced. P.$^{\underline{1}}$, $^{\underline{2}}$, $^{\underline{3}}$ much compressed and without even rudimentary posterior tubercles. Incisors very small.

Detailed Description of Type (No. 491).

The type of the present genus and species consists of a skull without lower jaw or other parts of the skeleton. It is complete save for the zygomata, the posterior portion of the sagittal crest, and the basicranial region between the pterygoids and the paroccipital processes. All the teeth are represented and in an excellent state of preservation save M.$^{\underline{3}}$ and I.$^{\underline{3}}$ and the extreme point of the canine. The specimen was found by Mr. O. A. Peterson, in the Oreodon beds, on Bad Land Creek, in Sioux Co., Nebraska.

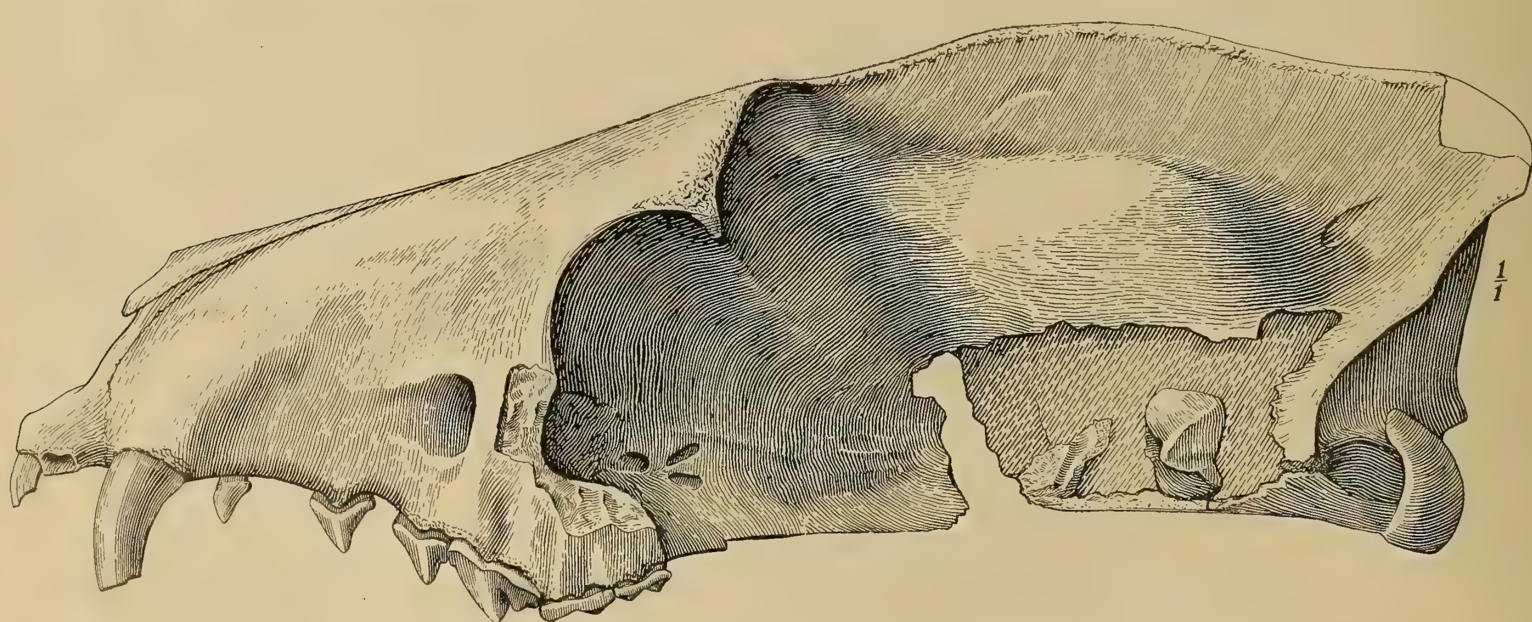


Fig. 6. Side view of type of *Proamphicyon nebrascensis* Hatcher (No. 491). Natural size.

The skull is long and compressed with the facial region somewhat less abbreviated than in *Daphœnus.* The capacity of the brain-case is rather less than in *Da-*

phœnus, while the sagittal and occipital crests are high and sharp. The sagittal crest extends a little farther forward than in that genus, while the frontals are not so broad, but somewhat longer. The occipital condyles are set obliquely, they are not much expanded and are overhung by the occipital crest. The foramen magnum is higher than wide, though this may have resulted from crushing. The basicranial region is so injured that it is impossible to determine any of its characters. The anterior palatine foramen is rather small. The anterior border of the posterior nares is on a line with the posterior border of M.$\underline{2}$.

The Dentition.—I.$\underline{1\&2}$ are small and very much compressed. I.$\underline{3}$ is wanting in our specimen on both sides, the alveoles show it to have been decidedly larger than I.$\underline{1\&2}$, but proportionately much smaller than in most recent dogs. The canine is large and elliptical in cross-section with a cutting posterior edge. It is longer and more slender than in *Daphœnus* and more nearly resembles the same tooth in *Amphicyon americanus* as described and figured by Wortman.[8] The character of this tooth is intermediate between that which obtains in *Daphœnus* and *Amphicyon*, although decidedly more like *Amphicyon*, as shown by the presence of a posterior cutting edge and its elliptical cross-section.

The three superior anterior premolars are all greatly reduced in size as shown in Fig. 7, a character also shown by *Amphicyon americanus*, according to Wortman's description, though not so apparent in his figures. The reduced size of these premolars is proportionately more pronounced than in any fossil dog I have yet seen, it even equals that which obtains in *Canis parvidens* among recent dogs. Premolars $\underline{1\&2}$ are separated from one another by a long diastema, and a somewhat shorter diastema intervenes between the canine and P.$\underline{1}$, while the space between P.$\underline{2\&3}$ is still less. Posteriorly P.$\underline{3}$ is in contact with the sectorial. The crowns of all three of these teeth consist of a single simple median cone without anterior or posterior tubercles. Premolar $\underline{1}$ is fixed by one root only, $\underline{2\&3}$ by two roots. Premolar $\underline{3}$ is set obliquely in the jaw. In all three of these teeth the anterior and posterior transverse diameters of each tooth are equal.

The sectorial or P.$\underline{4}$ is proportionately long and narrow. The anterior portion is not so broad as in *Daphœnus* and the internal cusp is low, a little more reduced than in *Daphœnus*, but not so much as in *Canis occidentalis* and the wolves generally. The proportions of this element are about the same as those which obtain in *C. lagopus* and certain others of the smaller recent dogs and foxes, as will be seen by a comparison of Fig. 4c with Fig. 7. The antero-external or principal cone is high and directed slightly backward. It is separated from the posterior cutting

[8]See Am. Jour. Sci., Vol. II, 1901, pp. 200–204.

blade by a rather deep groove. The latter element is low, sharp and oblique in position.

Molars $\frac{1\&2}{}$ are proportionately broad transversely and short antero-posteriorly. Each of these teeth supports two subequal external cones separated by a rather deep depression from a single crescentic internal cusp at the base of which is a broadly expanded basal cingulum. Strong basal cingula are also developed on the external sides of M.$\frac{1\&2}{}$, more especially M.$\frac{1}{}$, and on the antero-external angle this is developed into a considerable prominence. M.$\frac{3}{}$ is wanting on both sides of our specimen, but on the left it is represented by two alveoli, as shown in Fig. 7. These show it to have been rather large for a third molar and to have been aligned with the external margins of molars $\frac{1\&2}{}$.

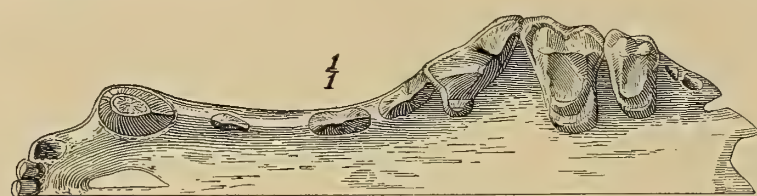


Fig. 7. Crown view of superior dentition of type of *Proamphicyon nebrascensis* Hatcher (No. 491). Natural size.

Measurements of Type (No. 491).

Length along palate and base of cranium from incisive alvelolar border to opening of foramen magnum	175	mm.
Greatest height of sagittal crest	25	"
Length of sagittal crest, estimated	92	"
Distance along median line from union of superciliary ridges to anterior extremity of nasals	86	"
Distance from posterior border of M.$\frac{3}{}$ to anterior border of I.$\frac{1}{}$	85	"
Antero-posterior diameter of canine at base	9.5	"
Transverse " " " "	6.5	"
Length of premolar series	37	"
" sectoral	12.5	"
" molar series	26	"
Antero-posterior diameter of M.$\frac{1}{}$	11	"
Transverse diameter of M.$\frac{1}{}$	16	"

Relations of Proamphicyon Nebrascensis.

After a careful comparison of the type of the present genus and species with Wortman's description and figures of *Amphicyon americanus* already referred to, the writer believes that the skull which forms the type of the present genus and species pertained to an animal intermediate in character between Daphœnus and Amphicyon and which stood in the line directly ancestral to the latter genus. The

most important resemblances between the present genus and Amphicyon are to be found in the dentition and have already been noticed. These may be recapitulated as follows :

First: Canine elliptical in cross-section or flattened transversely and with posterior cutting edge.

Second: Premolars $\frac{1}{}, \frac{2}{}, \frac{3}{}$ much reduced in size.

Third: Superior sectorial long and narrow.

Fourth: Molars $\frac{1 \& 2}{}$ much expanded transversely.

Fifth: Molar $\frac{3}{}$ large, as indicated by presence of two alveoli, and aligned with external border of M. $\frac{1 \& 2}{}$.

The cranial characters of the American species of Amphicyon are not sufficiently well known to permit of a comparsion of these characters in the two forms. Judging from the dental characters alone however the present genus would appear to fulfill all the requirements that we might reasonably except to find in a White River ancestor of the Miocene form, except that P.$\frac{1}{}, \frac{2}{}, \frac{3}{}$ are perhaps a trifle too much reduced in size. I therefore for the present regard *Proamphicyon nebrascensis* as ancestral to *Amphicyon americanus.*

PROTEMNOCYON INFLATUS, gen. et sp. nov., Plate XV.

Among the material collected by Mr. Peterson is a beautifully preserved skull (No. 552) with lower jaw, for which, from its evident relation to *Temnocyon,* I propose the genus *Protemnocyon.* In reference to the capacious nature of the brain cavity it is proposed to designate the species as *P. inflatus.*

Char. Gen. — Sagittal crest very low throughout the anterior two thirds of its length. Brain-cavity much inflated, indicating a brain one half larger in proportion to the size of the skull than that of Daphœnus or Proamphicyon. Dental formula, I.$\frac{3}{?}$, C.$\frac{1}{1}$, P.$\frac{4}{4}$, M. $\frac{3 \text{ or } 2}{3}$. Heel of inferior sectorial and M.$\frac{}{2}$ imperfectly keeled.

Char. sp. — Temporal constriction anterior to union of superciliary ridges. Frontals broad, gently concave medially, but convex laterally, indicating the presence of well-developed frontal sinuses. Inferior margin of mandible nearly straight. M.$\frac{3}{}$ much reduced in size or absent. P.$\frac{1}{1}, \frac{2}{2}, \frac{3}{3}, \frac{}{4}$ large and with broad heels.

DETAILED DESCRIPTION OF TYPE (No. 552).

The type of *Protemnocyon inflatus* consists of a skull with lower jaw, atlas, axis, and third cervical found in position in the Oreodon beds on Bad Land Creek, Sioux Co., Neb.

The Skull, Plate XV.

The skull is about one fourth smaller than that of *Daphœnus felinus* and is of about the same size as that of *D. hartshornianus*. Seen from above it appears broad and short, with a relatively very large brain-case and broad frontals when compared with Daphœnus or Proamphicyon. Throughout the anterior two thirds of its length the sagittal crest is reduced to a low sharp ridge rising just above the surface of the brain-case, as shown in Pl. XV., Figs. 1 and 2, in marked distinction from the conditions that obtain in this region in the two preceding genera. Posteriorly the sagittal crest is higher and unites with the high and sharp occipital crest which overhangs the occipital condyles. The frontals are broad and bear rather prominent and rugose postorbital processes from which superciliary ridges extend, converge and meet posteriorly at an acute angle to form the low, sharp sagittal crest. There is a marked lateral constriction in the facial region midway between the canine and the infraorbital foramen. The anterior process of the frontals is not so widely separated from the posterior projection of the premaxillaries as in Daphœnus. The nasals are rather broad anteriorly and bluntly pointed posteriorly. The premaxillaries are small and there is a constriction between the canine and $I.^{\underline{3}}$ for the accommodation of the lower canine.

Seen from the side the top of the skull appears nearly flat longitudinally with the facial region perhaps a little more elongate proportionately than in the preceding genera. The zygomatic arches are very slender and but moderately expanded. Posteriorly they do not expand so abruptly from the margins of the skull as in Daphœnus. The postglenoid processes are directed downward and slightly forward while the paroccipital processes point downward and backward at an angle of about forty-five degrees. The *foramen magnum* is broader than deep, as in modern dogs, although these proportions may have been materially altered by crushing.

Seen from below the palate appears broad and proportionately somewhat longer than in *Daphœnus* and *Proamphicyon*. The anterior palatine foramen is small. The anterior border of the posterior nares is a little posterior to the last molar. The pterygoid plates are continued far back and arch inward in such manner as to partially enclose the narial passage in this region, which in life was doubtless covered over inferiorly by a membrane. The foramen ovale and posterior opening of the alisphenoid canal have a common opening. The foramen rotundum, sphenoidal fissure and optic foramen are present, but the skull is too much crushed in this region to determine their character with certainty. As in Daphœnus the auditory bullæ are not preserved, doubtless through imperfect ossification. The periotic is present and is inflated to accommodate the cochlea. The postglenoid, condylar,

lacerum posterium and medium and other foramina of this region are preserved, though the outlines of some of them, owing to the absence of the auditory bullæ, are not well shown.

The Mandible.—The mandible (Pl. XV., Fig. 1, and Pl. XVI., Fig. 3) has the inferior border remarkably straight, much as in *Daphœnus hartshornianus.* The horizontal ramus retains the same depth throughout its entire length. The masseteric fossa is deep. The angular process is pronounced, the extremity is broken away in both rami, but it was apparently pointed and inclined upward and backward. The postero-external border rises almost perpendicularly from the base of the angular process to the condyle instead of inclining strongly backward as in *Daphœnus.* There are two mental foramina, of which the anterior lies directly beneath P.$_{\overline{1}}$, and the posterior beneath the middle of P.$_{\overline{3}}$. The position of both is midway between the alveolar and inferior borders. The symphysial area is small and the union was cartilaginous. The inferior dental foramen is situated rather low, near the inferior border of the ramus, and well back toward the base of the condyle. The coronoid process is injured, but enough is preserved to show that it was high and broad, and rose abruptly from the horizontal ramus at an angle of about 90 degrees.

The Dentition.

Superior Dentition.—Plate XV., Fig. 3. In the structure and arrangement of the teeth the present genus more nearly resembles those conditions which obtain in *Temnocyon coryphæus*, as described and figured by Cope (see Tertiary Vertebrata, p. 896, Pl. LXXI.), than any other species of dog known to the present writer. The alignment of the incisors is more oblique and not so nearly at right angles to the longer axis of the skull as in Daphœnus. This character is not so well shown in the figures as it might be. Incisors $^{\underline{1}}$ & $^{\underline{2}}$ are very small, subequal and much compressed. The position of I.$^{\underline{3}}$ is but little posterior to that of I.$^{\underline{1}}$. Compared with $^{\underline{1}}$ & $^{\underline{2}}$ I.$^{\underline{3}}$ is very large with its posterior border placed far behind that of I.$^{\underline{2}}$. Neither of these characters is sufficiently emphasized in Fig. 3, Pl. XV.

The canines are blunt through wear, stout and considerably compressed, but without anterior or posterior cutting edges.

Premolars $^{\underline{1}}$, $^{\underline{2}}$, $^{\underline{3}}$ are stout and well developed and separated from one another and the canine by short diastemata, while P.$^{\underline{3}}$ is nearly in contact with P.$^{\underline{4}}$. P.$^{\underline{1}}$ is fixed by a single root and consists of a simple cone directed obliquely forward and downward. Premolars $^{\underline{2}}$ & $^{\underline{3}}$ are supported by two roots, the heel of the former is not expanded transversely, but that of the latter is much expanded. The crowns of both these teeth consist of a single median cone without anterior or posterior tubercles.

In the sectorial the antero-internal cone is well developed, while the external or principal cone is proportionately a little lower than in *Daphœnus* or *Proamphicyon.* The posterior cutting blade is proportionately high. There is a well-developed basal cingulum on the external and anterior borders of this tooth.

Molar $\frac{1}{}$ is large and subquadrangular in outline, quite distinct from the same tooth in *Daphœnus hartshornianus*, as will appear from a comparison of the figure of that tooth shown in Pl. XV. with the figures of the same tooth of the last-mentioned species published by Scott in his "Notes on the Canidæ of the White River Oligocene," Fig. A, 2 and Pl. XIX., Fig. 2. The structure and form of this tooth is, in fact, intermediate between that of *D. hartshornianus* and *Temnocyon coryphæus*, though more closely resembling the latter. The external cusps are subequal and situated well within the external border. The internal cusp is separated from the externals by a deep median valley. The intermediate tubercles are faint. The internal basal cingulum is strong and developed into a prominent cone on the postero-internal angle. There is a basal cingulum on the external border of this tooth. M.$\frac{2}{}$ is much smaller but of the same general pattern as M.$\frac{1}{}$ except that the postero-external cone is much smaller than the antero- and occupies a more external position than the latter. M.$\frac{3}{}$ is wanting on either side in the present specimen. But on the left side there is preserved what appears to be a single very small alveolus not shown in the figure. This indicates that this tooth may have been present, but if so, was much reduced in size.

Inferior Dentition. Pl. XVI., Fig. 3.

The incisors are wanting in both rami and hence nothing can be said concerning their character.

The canine is compressed laterally but without anterior or posterior trenchant edges.

The crown of P.$\overline{1}$ consists of a compressed cone, elliptical in cross-section and directed strongly forward. It is fixed in the jaw by one root.

The succeeding premolars are each supported by two fangs and the crowns grow successively stronger from the second to the fourth. They are not reduced in size and separated by but slight diastemata. All bear well-developed basal cingula on their posterior borders, and in addition to the principal median cone there is present on P.$\overline{4}$ a prominent posterior conule.

The inferior sectorial, M.$\overline{1}$ consists of a prominent anterior trigon and a low basal heel. The external cone of the trigon is the strongest and highest, while the postero- and antero-internal cones are smaller and subequal in height and strength.

The structure of the talon has been somewhat obliterated by wear, but it appears to have been composed of a large median cone or ridge homologous with the external cone of the heel in Daphœnus and a rudimentary internal cone.

$M._{\overline{2}}$ is much reduced in size and its structure has been obliterated by wear to such an extent that it is impossible to determine its exact character.

$M._{\overline{3}}$ is wanting on both sides, but the single rather small alveolus indicates that it was much reduced in size.

The Vertebræ. Pl. XVIII., Figs. 6, 7, 8.

Of the vertebræ only the atlas, axis, and the third cervical are preserved. These, as in Daphœnus, are feline rather than canine in character. The transverse processes of the atlas are wanting. The articular surfaces for the occipital condyles are deeply concave and rather widely expanded, while those for the axis are nearly flat and but little expanded, diverging from the longitudinal axis at an angle of scarcely more than fifteen degrees. The vertebrarterial canal is somewhat intermediate in character between that of the dogs and cats. It enters on the inferior side at the middle of the base of the transverse process and emerges posteriorly at the supero-posterior border of the base of the same process, instead of directly in the middle, as in Daphœnus and modern cats. The position of the posterior opening of the vertebrarterial canal in the present genus and species while still similar to that which obtains in Daphœnus and the cats is clearly shifting to that which it occupies in the dogs. In this respect Protemnocyon may be considered as having made a distinct advance over Daphœnus in the direction of recent dogs.

The axis is in a splendid state of preservation. The spine is high and sharp, and posteriorly it is continued into a long peg-like process as in the cats instead of being truncated as in the dogs. The odontoid process is peg-like. There are rather slender transverse processes directed backward and slightly downward. Inferiorly there is on the centrum a sharp median keel. Cervical three does not differ materially from the same vertebra in recent cats.

Principal Measurements of Type (552).

Greatest length of skull	167	mm.
" breadth "	85	"
Length of sagittal crest	68	"
Breadth of cranium at greatest temporal constriction	23.5	"
Greatest breadth of cranium	46	"
" " frontals	36	"
Length of palate	81	"
Distance from incisive alveolar border to anterior border of orbit	65	'

Greatest length of lower jaw	116	mm
Depth of lower jaw below $\mathrm{M.}_{\overline{2}}$	19	"
" " " " $\mathrm{P.}_{\overline{2}}$	16	"
Height of coronoid process	56	"
Length of sup. premolar-molar series	58	"
" " " series	43	"
" " sectorial	15	"
Breadth " "	9.5	"
" " $\mathrm{M.}^{\underline{1}}$	15.5	"
" " " $^{\underline{2}}$	11	"
Antero-posterior diameter of sup. canine at base of crown	8.5	"
Transverse " " " " "	6	"
Length of inferior premolar-molar series	65	"
" " " series	38	"
" " sectorial	16	"
" " $\mathrm{P}_{\overline{4}}$	11	"
Breadth " "	5.5	"
Antero-posterior diameter of lower canine	9	"
Transverse " " "	5	"
Expanse of condylar cotyloids of atlas	32	"
Length of centrum of axis including odontoid process	44	"

Relations of Protemnocyon Inflatus.

From the foregoing description and the accompanying figures it will readily appear that the type of the present genus and species very closely resembles Cope's *Daphœnus hartshornianus* and there is no doubt that the two are generically identical, though the species are easily distinguishable by the structure of the second inferior molar and of $\mathrm{P.}^{\underline{3}}$. From several characters already pointed out in the description of both the present and the preceding genus it has appeared to the writer best to subdivide Daphœnus into two genera, viz., *Daphœnus* and *Protemnocyon*, including in the latter Cope's species, described as *D. hartshornianus*, which would then be known as *Protemnocyon hartshornianus*.

The present genus appears to stand directly ancestral to *Temnocyon coryphæus* Cope of the John Day. The relationships between the two are shown not only in the dentition, but by certain characters exhibited by the skull and mandible as well. Among the latter may be mentioned *the capacious brain-case, reduced sagittal crest, broad frontals, slender and straight mandible*. *T. coryphæus* has advanced so far beyond *P. inflatus* as to have completely ossified tympanics, which appear as large inflated auditory bullæ. The molars are also much more reduced in the John Day form, the second tubercular having become much smaller than in Protemnocyon of the White River, while the third has disappeared entirely, as might be expected from the exceedingly reduced nature of that tooth in *P. hartshornianus* and *inflatus*, the earlier forms.

CYNODICTIS GREGARIUS Cope.

There are in our collections a number of skulls associated with more or less complete skeletons which I have referred to the above genus and species. With the exception of the os penis which has already been described, these remains throw no new light on the osteology of that genus of Oligocene dogs and hence require no further reference here.

CONCLUSIONS.

The principal object in the preparation of the present paper has been to give to students of the Canidæ, in so far as possible, an accurate description of the osteology of *Daphœnus felinus*, supplemented by good figures based upon the skeleton of a single individual. With the exception of the scapula, pelvis, and certain of the vertebræ and sternals our skeleton, No. 492, is exceptionally complete and thus affords a safe and reliable guide to the osteology of at least one species of Oligocene dogs. After a prolonged and careful comparative study of this skeleton, together with the associated material in our collections, the present writer was forced to the conclusion that among the larger White River Canidæ there are represented three distinct genera two of which had been previously unrecognized, all having been heretofore referred to the single genus *Daphœnus*. Of these three genera two, Daphœnus and Proamphicyon, include species which are larger than those of the third and may be referred to collectively as dolichocephalic or long-skulled, while those belonging to the third genus, *Protemnocyon*, are smaller and brachycephalic or short-skulled.

Briefly these three genera, which in fact represent three distinct phyla, may be characterized as follows:

1. DAPHŒNUS.—*Skull elongate, sagittal crest high, brain-case reduced, canines stout and round without anterior or posterior cutting edges, premolars strong and, save in* D. DODGEI, *with* $M.\frac{3}{}$ *small and aligned with internal cones of preceding molars, position of vertebrarterial canal in atlas as in the cats. No known descendant.*

2. PROAMPHICYON.—*Skull elongate; sagittal crest high; brain-case reduced; canines long, compressed and with posterior cutting edge; premolars much reduced in size and well spaced;* $M.\frac{3}{}$ *large with two roots? Ancestral to* AMPHICYON *of the Loup Fork.*

3. PROTEMNOCYON.—*Skull short; sagittal crest low; brain-case large; canines compressed but without cutting edges; premolars strong and rather closely set;* $M.\frac{3}{}$ *very small or absent; position of vertebrarterial canal of atlas intermediate between dogs and cats; ancestral to Temnocyon of the John Day.*

Concerning the very difficult subject of the relations of the Oligocene canidæ to recent forms, the present writer does not feel competent to enter into a discussion,

especially with the very limited osteological material at his command with which to make the necessary comparisons. From the many feline characters which have been shown to occur in *Daphœnus* and other Oligocene dogs and from the many skeletal characters held in common by these dogs and the contemporaneous Machairodonts there would seem but little doubt that both these groups as well as the true felidæ came from a common ancestral stock which most likely belonged to some member of the *Creodonta adaptiva* of Matthew in the early Eocene.

In a paper entitled "The Ancestry of Certain Members of the Canidæ, the Viverridæ and Procyonidæ," published as Article VI. of Vol. XII. of the American Museum Bulletin, Wortman and Matthew have devoted a great deal of attention to the phylogeny of certain genera and species of recent canidæ. With characteristic ingenuity and commendable patience they have developed and proposed two lines of descent, one for the Dholes, and another for those South American foxes with reduced premolars, *Canis urostictus, parvidens,* etc. Considering that these theoretical phylogenies are, for the most part, based on tooth-structure alone, and that throughout vast periods of time we have not yet discovered the intermediate forms which must of necessity have existed, such phylogenetic work while extremely interesting, not to say alluring, must necessarily be quite provisional and theoretic, and it would therefore seem to the present writer a little premature to say that "The Dhole or Red Dog of India (Cyon) can be confidently considered as the living representative of the John Day genus Temnocyon" when not a single intermediate form is known from the close of the Oligocene to recent times. By this I do not mean to deprecate such attempts at working out the ancestry of living animals, which is and should be one of the chief aims of the paleontologist, but rather to emphasize how fragmentary our actual knowledge of the ancestors of the modern canidæ really is. Of the extinct canidæ of North America we are fairly well acquainted with the osteology of but four genera, *Vulpavus* of the Eocene, and *Cynodictis, Daphœnus* and *Temnocyon* of the Oligocene.

The plates accompanying this paper were drawn by Mr. F. von Iterson, the text figures by Mr. Sidney Prentice.

CARNEGIE MUSEUM, July 15, 1902.

Explanation of Plates.

Plate XIV. Fig. 1. Top view of skull of *Daphnœus felinus* Scott (No. 492). Natural size.

Fig. 2. Side view of same skull. Natural size.

Plate XV. Fig. 1. Side view of skull of *Protemnocyon inflatus* Hatcher, type (No. 552).

Fig. 2. Top view of same.

Fig. 3. Inferior view of right side of same. All figures natural size.

Plate XVI. Fig. 1. Inferior view of posterior portion of skull of *Cynodictis gregarius* Cope (No. 493).

Fig. 2. Left ramus of *Daphœnus felinus* Scott (No. 492). Seen from inner side.

Fig. 3. Crown view of right ramus of *Protemnocyon inflatus* Hatcher, type (No. 552).

Fig. 4. Crown view of right ramus of *Daphœnus felinus* Scott (No. 492).

Fig. 5. Inferior view of left side of skull of *Daphœnus felinus* Scott (No. 492). Incisors and $P.\frac{1}{}$ conjectural, remaining teeth in part restored from No. 553. All figures nutural size.

Plate XVII. Vertebræ of *Daphœnus felinus* Scott (No. 492).

Figs. 1, 2, 3. Inferior, superior, and posterior views of atlas.

Fig. 4. Fifth dorsal, seen from right side.

Fig. 5. Thirteenth dorsal, seen from right side.

Figs. 6, 7. First caudal, seen respectively from right side and above.

Figs. 8, 9, 10, 11, 12. Superior views of fifth, seventh, ninth, thirteenth and twenty-first caudals.

Figs. 13, 14, 15. Lumbars, 2, 4, 7, seen from right side.

All figures natural size.

Plate XVIII. Fig. 1. Mesosterni 1–5 of *Daphœnus felinus* Scott (No. 492), seen from above

Figs. 2, 3. Os penis of *Cynodictis gregarius* Cope (No. 493), inferior and lateral views.

Figs. 4, 5. Os penis of *Daphœnus felinus* Scott (No. 492), inferior and lateral views.

Fig. 6. Axis of *Protemnocyon inflatus* Hatcher (No. 552), seen from left side.

Fig. 7. Superior view of atlas of same, seen obliquely from behind.

Fig. 8. Left side of third cervical of same.

Fig. 9. Front view of right-hind foot of *Daphœnus felinus* Scott (No. 492).

Fig. 10. Front view of right fore foot of same.

All figures natural size.

PLATE XIX. Limb bones of *Daphœnus felinus* Scott (No. 492).

Fig. 1. Front view of right femur.

Fig. 2. Distal end of same.

Fig. 3. Front view of right tibia.

Fig. 4. Distal end of same.

Figs. 5, 6. Internal and external views of right fibula.

Fig. 7. Posterior view of right humerus.

Figs. 7[a], 8. Distal and proximal ends of same.

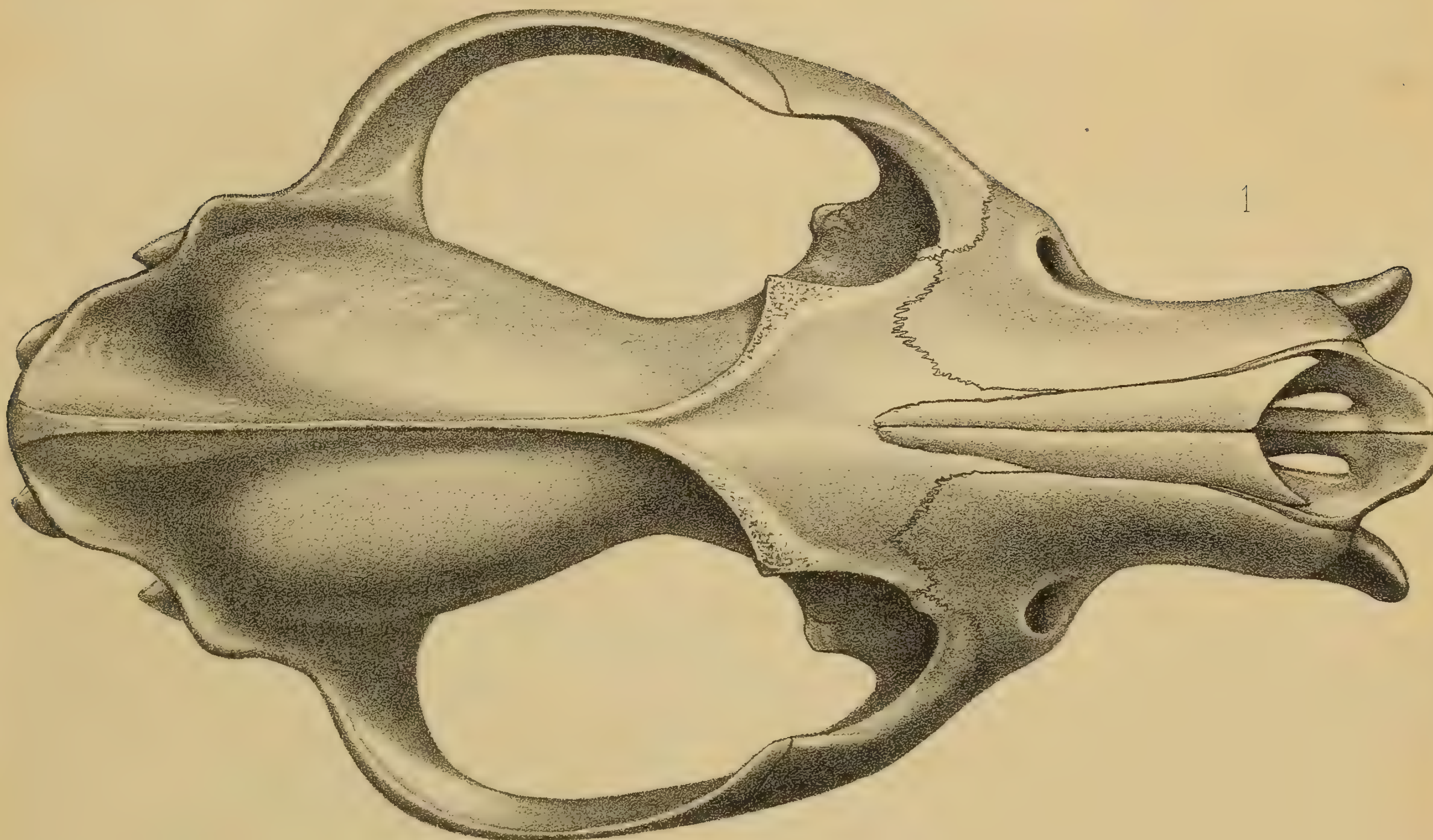
Fig. 9. Posterior view of right radius.

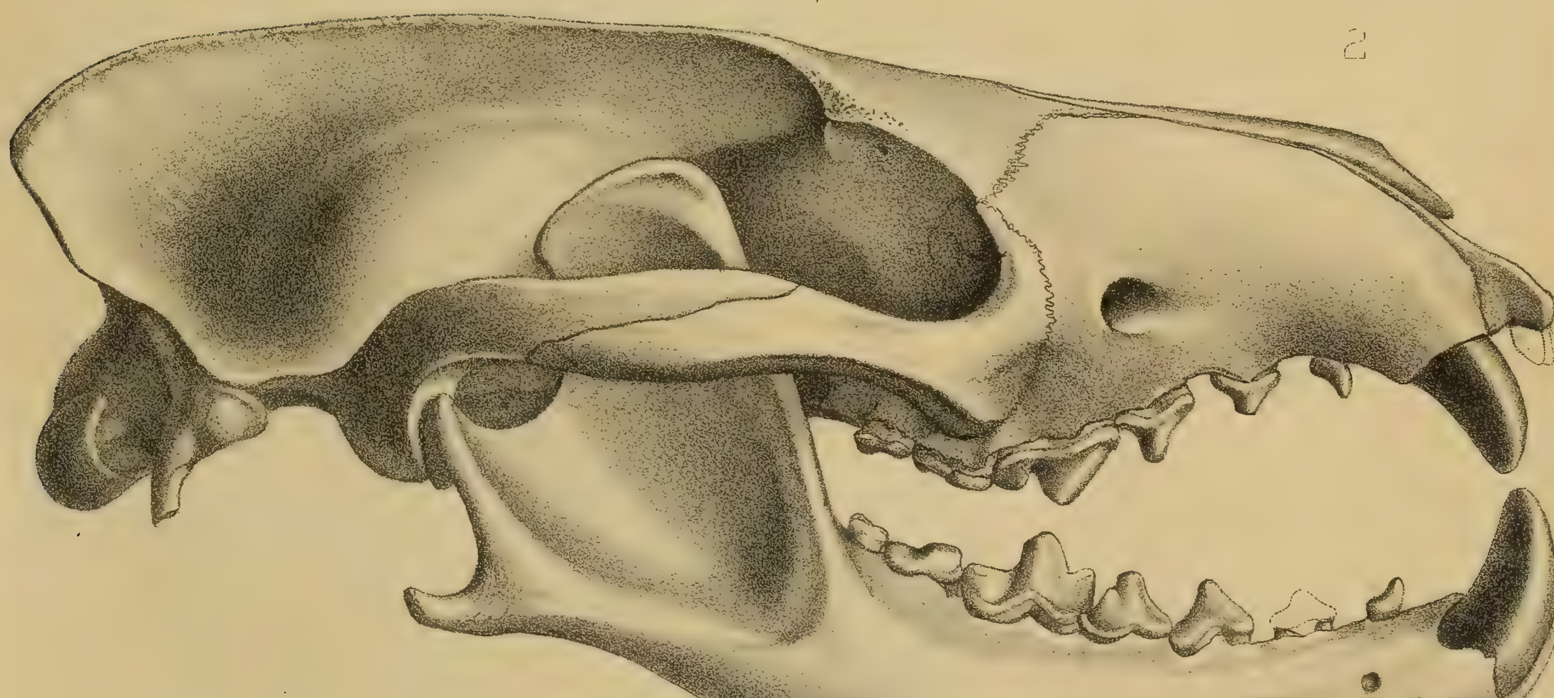
Figs. 10, 11. Proximal and distal ends of same.

Fig. 12. Front view of right ulna.

All figures natural size.

PLATE XX. Mounted skeleton of *Daphœnus felinus* Scott (No. 492) $\frac{1}{6}$ natural size.





F. v. Iterson, del. et Lith.

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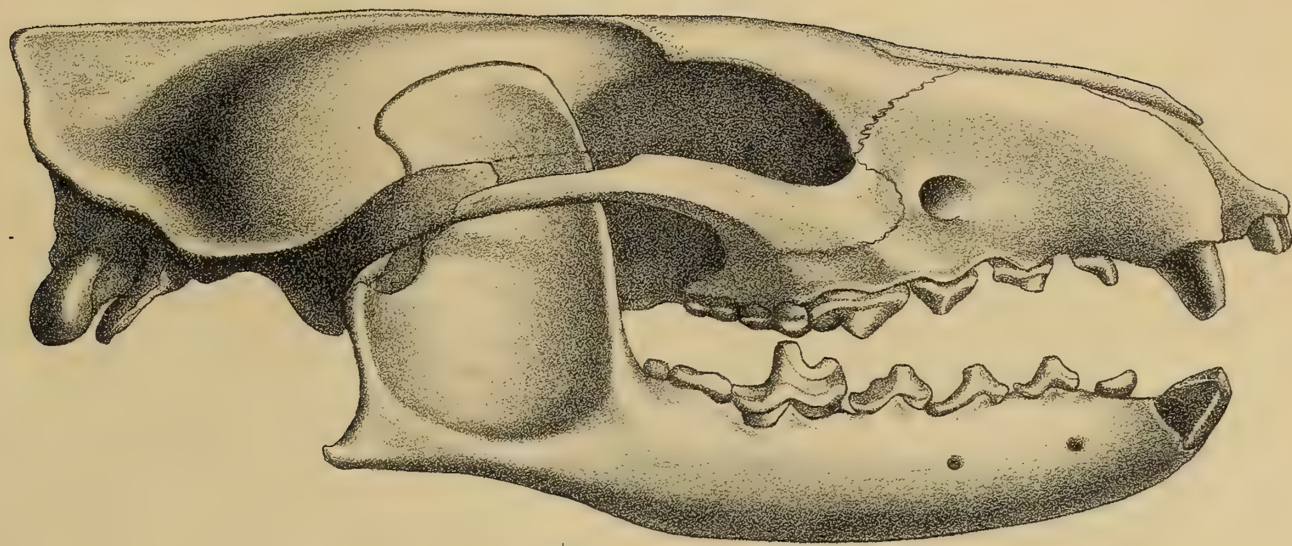
OLIGOCENE CANIDAE.



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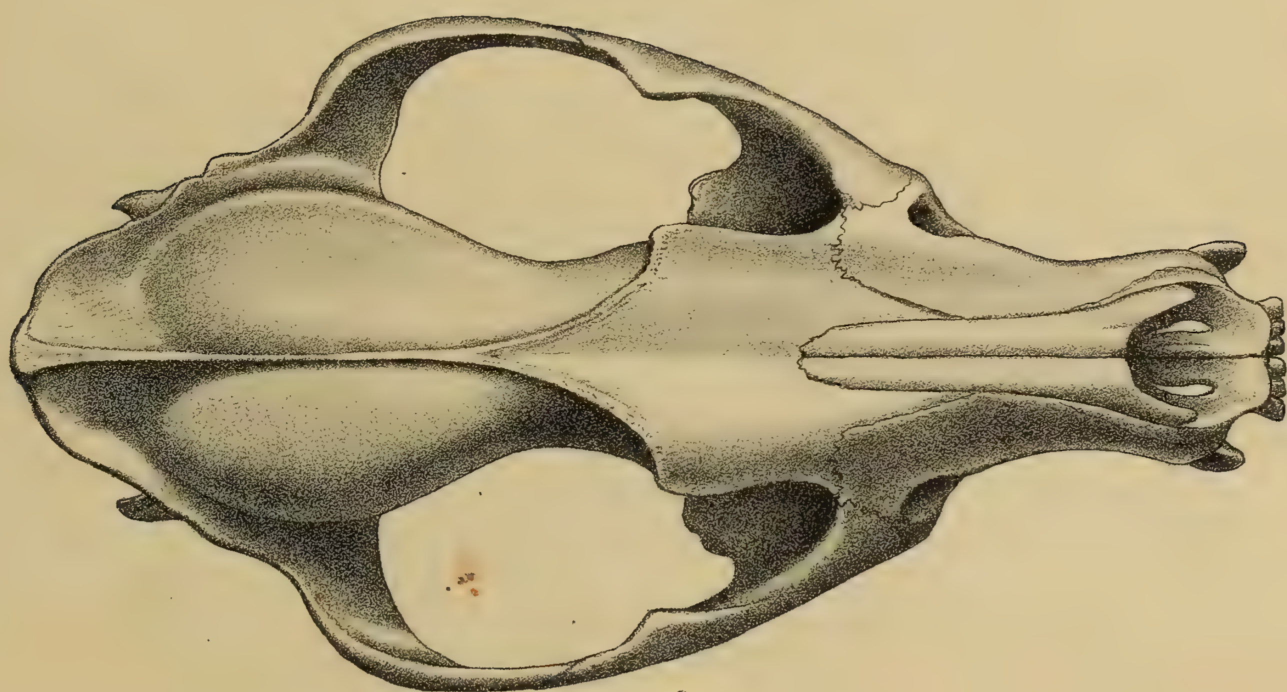

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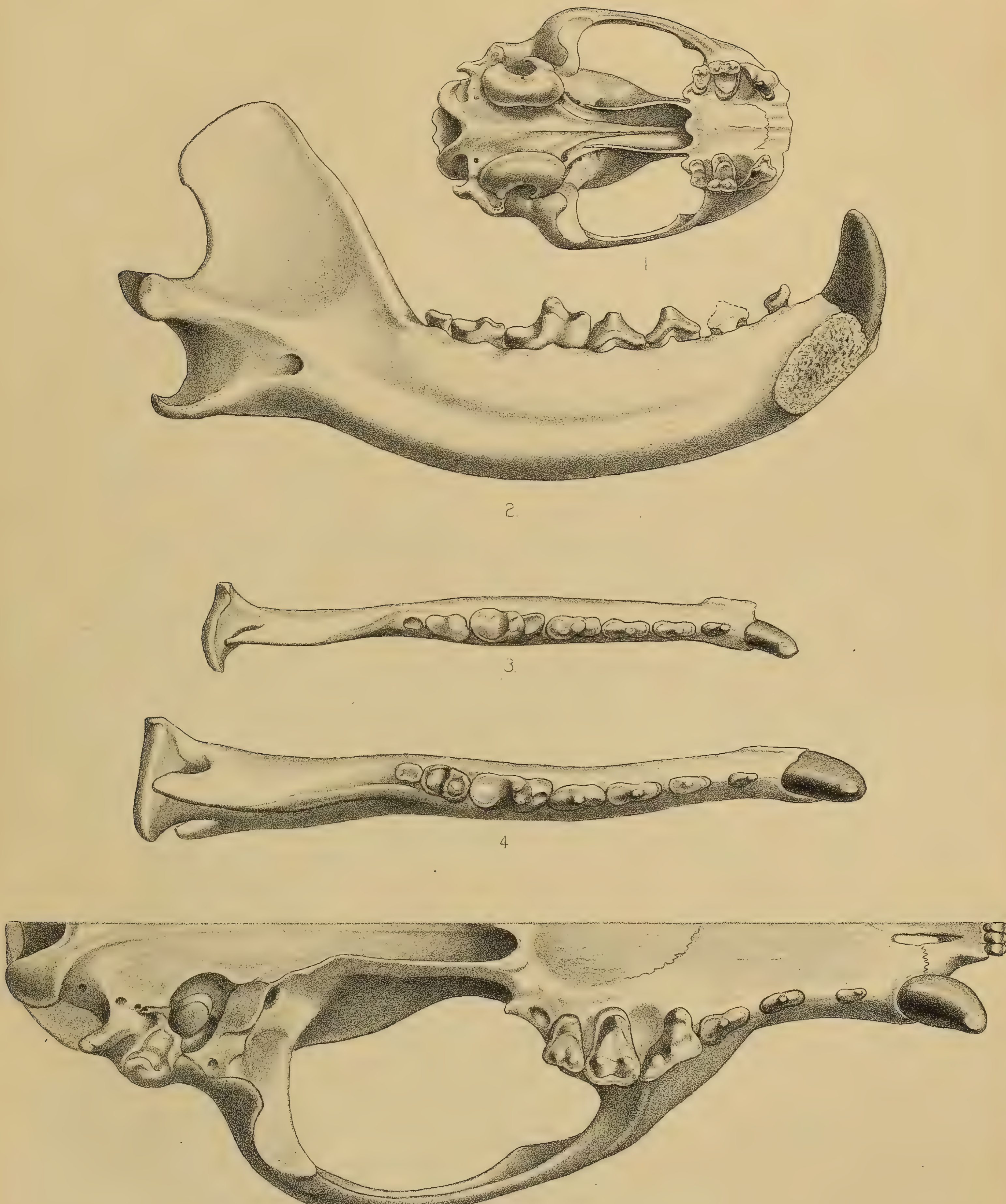

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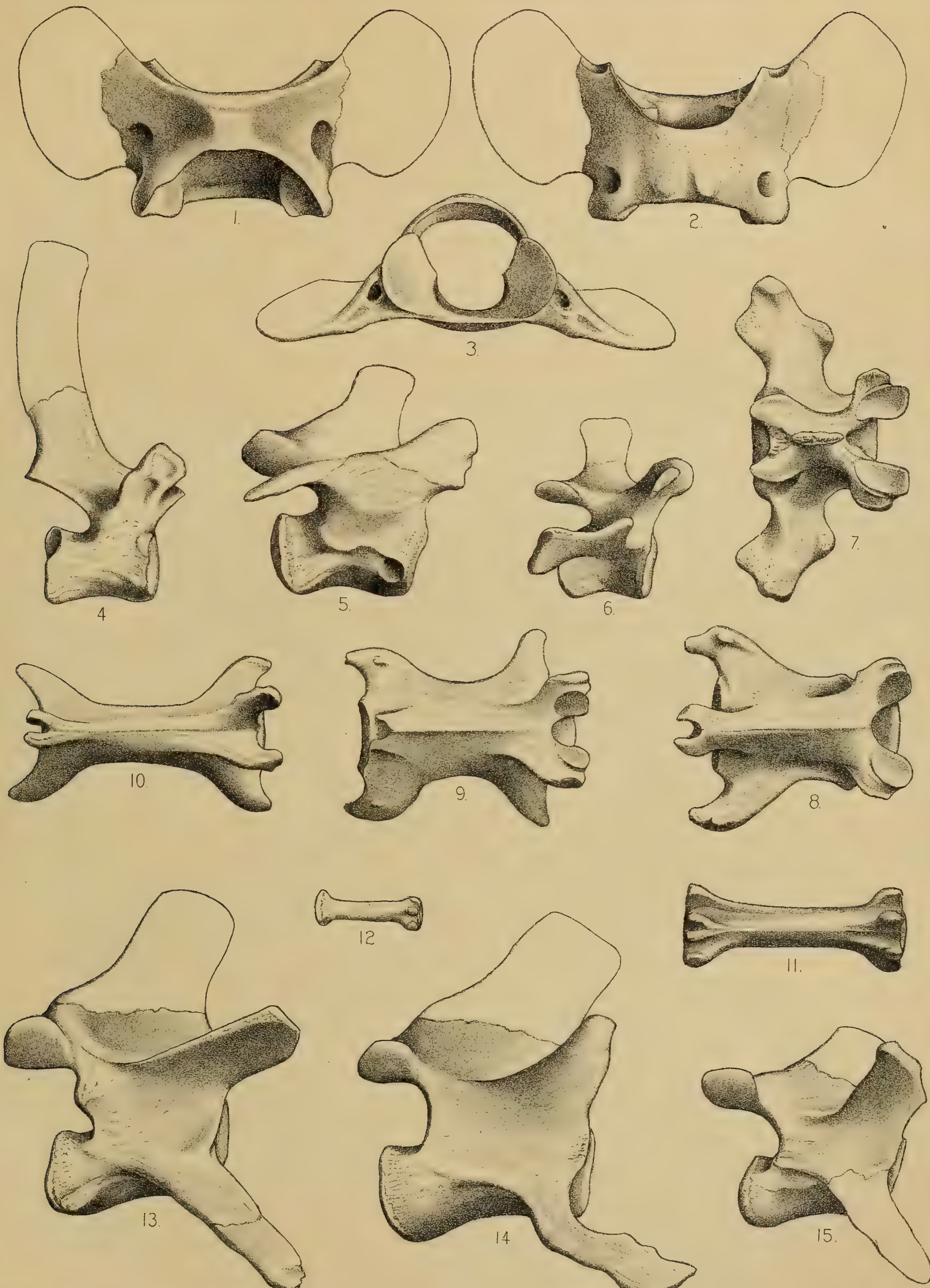

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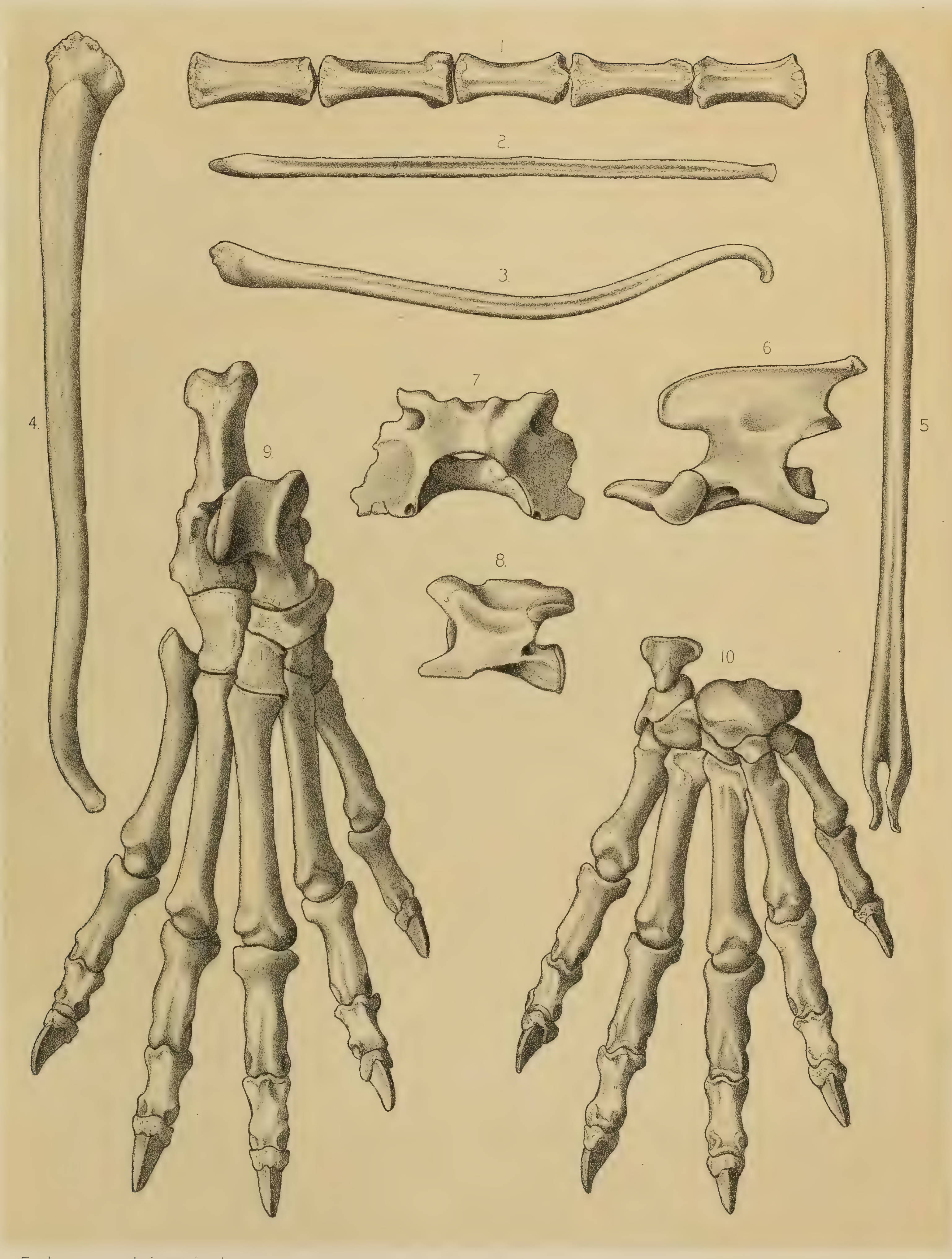

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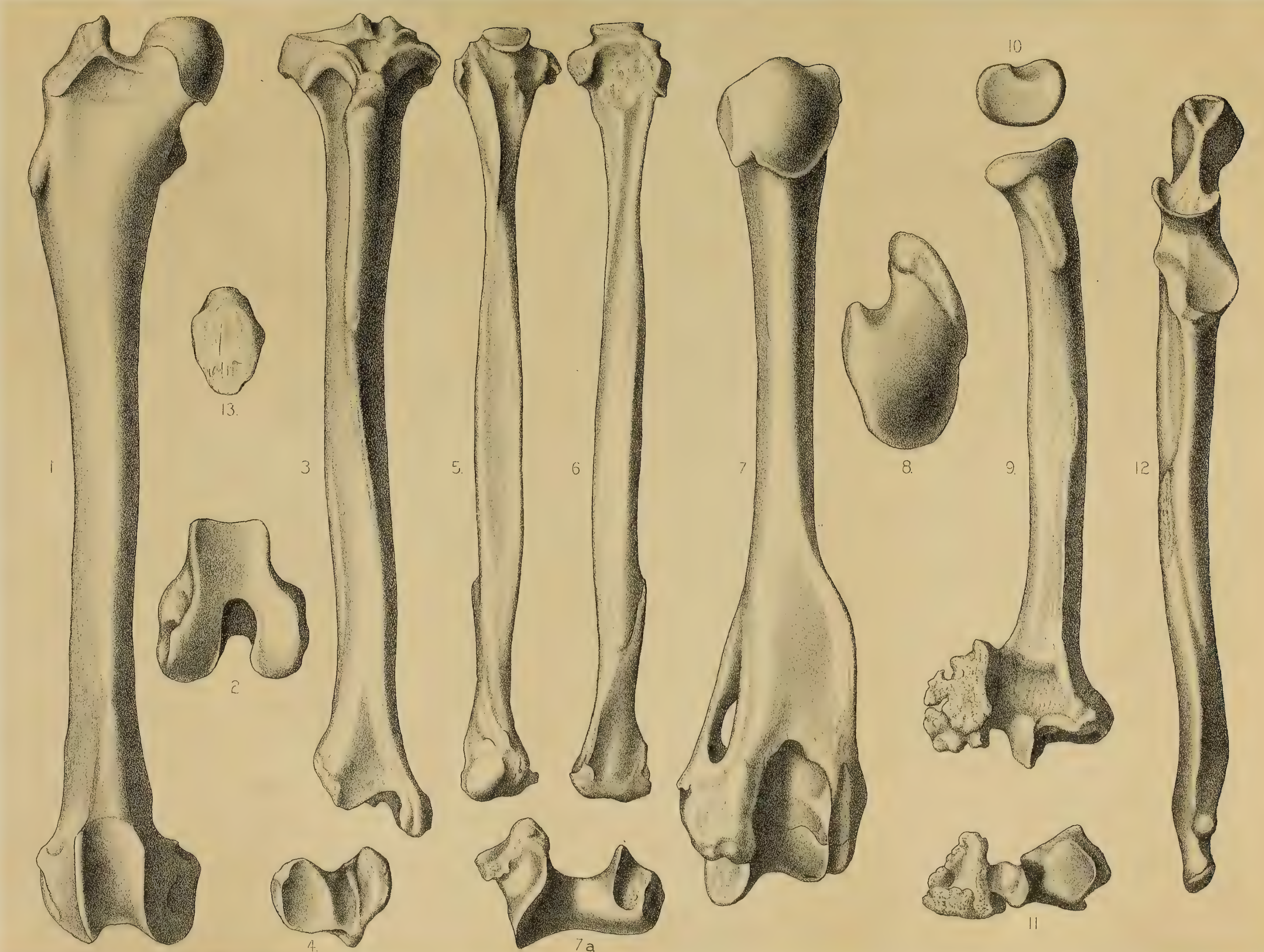

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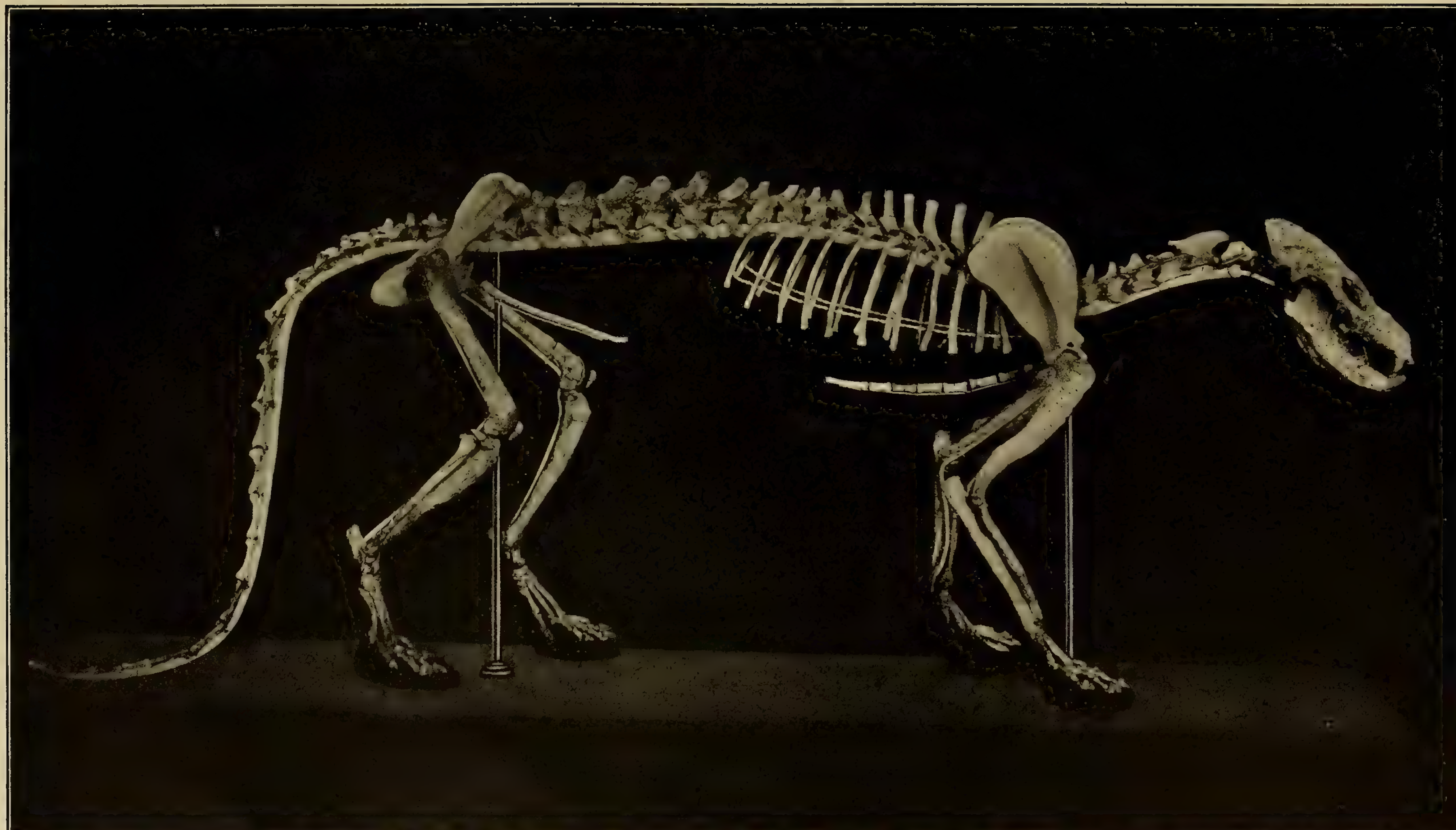


SKELETON OF DAPHŒNUS FELINUS Scott, $\frac{1}{6}$ natural size. Discovered by O. A. Peterson; mounted by Arthur S. Coggeshall.
Carnegie Museum, Dept. of Paleontology (No. 492).

MEMOIRS

OF THE

CARNEGIE MUSEUM.

VOL. I. NO. 3.

THE OSTEOLOGY OF THE STEGANOPODES.

By R. W. Shufeldt, M.D.

At the present writing it is a little over nineteen years ago since I first paid any attention to the osteology of the steganopodous birds. My initial paper upon this subject was a brief one devoted to the osteology of *Phalacrocorax bicristatus* (*Science,* Vol. 2, No. 41, Nov. 16, 1883, pp. 640–642, 3 figs.).[1] The figures illustrating that paper have since been used in text-books on ornithology and zoölogy to some extent. As will be observed in the body of the present memoir, five years later I published another contribution to this subject, entitled "Observations upon the Osteology of the Orders Tubinares and Steganopodes" (Proc. U. S. Nat. Mus., Vol. XI., 1888, pp. 253–315, 43 figs. in text); and also in January, 1889, "Notes on Brewster's and the Blue-footed Gannet" (*The Auk,* Vol. VI., No. 1, p. 67). What I have done in the matter of fossil birds of this suborder, will be chiefly found in my memoir, "A Study of the Fossil Avifauna of the Equus Beds of the Oregon Desert" (*Jour. Acad. Nat. Sci. Phila.*, Vol. XI., Pls. XV.–XVII, (4to), Phila., Oct., 1892, pp. 389–425), and a number of abstracts of the same, subsequently published elsewhere, as in *The American Naturalist,* and *The Auk.* In 1894, in the Proceedings of the Zoölogical Society of London, I published a brief paper "On the Affinities of the Steganopodes" (Feb. 20, pp. 160–162), and in the *Ibis* of the same year, in a paper entitled "On Cases of Complete Fibulæ in Existing Birds," made a study of the fibula in the *Sulidæ* (Vol. VI., No. 23, London, July, 1894, Art. XXIX., pp. 361–366, figs. 1, 2). *The Auk* also published a paper of mine in October, 1894, making

[1] See also *ibid.*, p. 822; also Vol. III., No. 53, Feb. 8, 1884, p. 143; also a rejoinder to Dr. Theo. N. Gill, *ibid.*, III. No. 63, pp. 474, 475, Apr. 18, 1884.

certain references to these birds, it being entitled, "Notes on the Steganopodes and on Fossil Birds' Eggs" (Vol. XI., No. 4, pp. 337–339); and there was likewise a note published about them on November 6, 1894 (*P. Z. S.*, p. 608).

Since then and up to the present time, (October, 1902), no paper or publication of any importance whatever of mine has been published about the *Steganopodes*, and especially about their osteology. In this interim, however, I made, as far as the material at hand would permit me, a more or less extensive study of the osteology of the entire group. These researches from time to time were written out and with them incorporated the facts brought out in my earlier publications. As time passed on, too, Mr. F. A. Lucas, of the U. S. National Museum at Washington, published a number of very important and interesting papers on the osteology of the *Steganopodes*, and as two of the best of these were of no great length, they likewise, with their figures, are herewith incorporated.

Moreover, during the last seven or eight years, Mr. Lucas with great industry has collected together for the osteological collections of the U. S. National Museum the finest series of skeletons of steganopodous birds existing anywhere in any institution in the world. With great courtesy and marked generosity Mr. Lucas has placed all this material at my disposal, to be studied and utilized in the present connection, and for this and for many other favors in the same direction, altogether too numerous to mention, my most sincere thanks are due to that distinguished anatomist. I am greatly indebted, too, to the courtesy of the U. S. National Museum in allowing me to take to my residence in Washington, from time to time, specimens to be photographed by me, which latter, being reproduced, form the material representing many of the figures in my plates. My private collections have likewise furnished specimens not as yet existing in the U. S. National Museum, and, as will be seen, a number of these will also be found among my figures on the plates. I am also indebted to other persons who have kindly collected material for me, but I believe in each case such assistance is duly noticed in the body of the present memoir. It also gives me pleasure to extend my thanks to my wife Alfhild for having made a very fair and correct copy of the notes I have collected on the osteology of the *Steganopodes* for a number of years past, and these may now be presented in the following manner:

We have this suborder of birds very fully represented in the North American avifauna. Of the first family in it to be considered in this memoir,—the *Phaëthontidæ* or Tropic Birds, we have at least two good species, viz:—*Phaëthon flavirostris*, the Yellow-billed Tropic Bird, and *P. æthereus*, the Red-billed Tropic Bird. Gannets of the family *Sulidæ* are still more numerous, but they all belong, apparently, to the

genus *Sula*. There is *S. cyanops*, *S. sula*, *S. brewsteri*, *S. gossi*, *S. piscator*, and finally, the well-known Gannet *Sula bassana*. The *Anhingidæ* or Darters, are represented by the common Anhinga, or Snake Bird, (*Anhinga anhinga*). Ornithologists have placed all our Cormorants in the genus *Phalacrocorax*, (*Phalacrocoracidæ*), and of them, species and subspecies taken together, there seem to be nearly a dozen varieties. Next we have three Pelicans of the family *Pelecanidæ;* these are *Pelecanus erythrorhynchus*, the American White Pelican; *P. fuscus*, the Brown Pelican; and lastly, *P. californicus*, the Californian Brown Pelican. Finally, there is the Man-o'-War Bird, *Fregata aquila* of the family *Fregatidæ*, — a conspicuous steganopod of tropical and subtropical coasts generally.

Newton has said "that the tropic birds form a distinct family, *Phaëthontidæ*, of the *Steganopodes* (the *Dysporomorphæ* of Professor Huxley), was originally maintained by Brandt, and is now generally admitted, yet it cannot be denied that they differ a good deal from the other members of the group;[2] indeed, Professor Mivart, in the Zoölogical *Transactions* (X., p. 364) will hardly allow *Fregata* and *Phaëthon* to be Steganopodons at all; and one curious difference is shown by the eggs of the latter, which are in appearance so wholly unlike those of the rest. The osteology of two species has been well described and illustrated by Professor Alph. Milne-Edwards in M. Grandidier's fine *Oiseaux de Madagascar* (pp. 701–704, pls. 279–281 a)."[3]

The same distinguished authority has remarked of the *Sulidæ* that "structurally the Gannet presents many points worthy of note, such as its closed nostrils, its aborted tongue, and its toes all connected by a web — characters which it possesses in common with most of the other members of the group of birds (*Steganopodes*) to which it belongs. But more remarkable still is the system of subcutaneous air-cells, some of large size, pervading almost the whole surface of the body, communicating with the lungs, and capable of being inflated or emptied at the will of the birds This peculiarity has attracted the attention of several writers—Montagu, Professor Owen, (*Proc. Zoöl. Soc.*, 1831, p. 90), and Macgillivray; but a full and particular account of the anatomy of the Gannet is still to be desired."

Some of our *Sulidæ*, as *S. sula*, *S. cyanops*, and *Sula piscator* are known as Boobies, from their apparent excessive stupidity, but which the writer pleases to call too little dread or fear of the great destroyer — man. Sailors are very prone to the taking of bird-life without stint and for no other purpose than amusement, whenever they get the opportunity upon lonely islands where sea-fowl abound. Myriad.

[2] *Sulidæ* (Gannet), *Pelecanidæ* (Pelican), *Plotidæ* (Snake-Bird), *Phalacrocoracidæ* (Cormorant), and *Fregatidæ* (Frigate-Bird).

[3] Newton, Al., F.R.S. Art. "Tropic-Bird," Encycl. Brit., 9th Ed., Vol. XXIII., p. 588, 1888.

of Penguins and Gannets have thus perished. Superficially a Booby is distinguished from a Gannet in that the former lacks the median stripe of naked skin over the region of the throat, so characteristic of the latter birds. As a rule, too, Boobies are tropical species, and breed in trees, and are of wide distribution.

Morphologically, the genus *Anhinga* has received more attention than any other of the Steganopods. "Beside the excellent description of the American bird's alimentary canal furnished to Audubon by Macgillivray, other important points in its structure have been well set forth by Garrod and Forbes in the Zoölogical *Proceedings* (1876, pp. 335–345, pls. XXVI.–XXXIII.; 1878, pp. 679–681; and 1882, pp. 208–212), showing among other things that there is an appreciable anatomical difference between the species of the New World and of the Old; while the osteology of *P. melanogaster* has been admirably described and illustrated by Professor Milne-Edwards in M. Grandidier's great *Oiseaux de Madagascar* (pp. 691–695, pls. 284–285). In all the species the neck affords a feature which seems to be unique. The first seven of the cervical vertebræ form a continuous curve with its concavity forward, but the eighth articulates with the seventh nearly at a right angle, and, when the bird is at rest, lies horizontally. The ninth is directed downwards almost as abruptly, and those which succeed present a gentle forward convexity. The muscles moving this curious framework are as curiously specialized, and the result of the whole piece of mechanism is to enable the bird to spear with facility its fishy prey." (Newton, Arts "Gannet," and "Snake-Bird," *loc. cit.*, p. 188.

Again we find the same eminent ornithologist under the article "Frigate-Bird"[4] declaring that that interesting Steganopod "was placed by Linnæus in the genus *Pelecanus,* and until lately its assignment to the family *Pelecanidæ* has hardly ever been doubted. Professor Mivart has, however, now declared (*Trans. Zoöl. Soc.*, X., p. 364) that, as regards the postcranial part of its axial skeleton, he cannot detect sufficiently good characters to unite it with that family in the group named by Professor Brandt *Steganopodes.* There seems to be no ground for disputing this decision so far as separating the genus *Fregata* from the *Pelecanidæ* goes, but systematists will probably pause before they proceed to abolish the *Steganopodes,* and the result will most likely be that the Frigate-Birds will be considered to form a distinct family (*Fregatidæ*) in that group. In one very remarkable way the osteology of *Fregata* differs from that of all other birds known. The furcula coalesces firmly at its symphysis with the carina of the sternum, and also with the coracoids

[4] "'Man-of-War Bird' is also sometimes applied to it, and is perhaps the older name, but is less distinctive, some of the larger Albatrosses being so called, and, in books at least, has generally passed out of use." [Man-o'-war Bird is the vernacular name given to this species in the A. O U. Check-list of North American Birds, and is the one in common use by ornithologists in the United States.]

of the upper extremity of each of its rami, the anterior end of each coracoid coalescing also with the proximal end of the scapula. Thus the only articulations in the whole sternal apparatus are where the coracoids meet the sternum, and the consequence is a bony framework which would be perfectly rigid did not the flexibility of the rami of the furcula permit a limited amount of motion. That this mechanism is closely related to the faculty which the bird possesses of soaring for a considerable time in the air with scarcely a perceptible movement of the wings can hardly be doubted, but the particular way in which it works has yet to be explained" (*loc. cit.*, Vol. IX., p. 786).

Among others, the birds we propose to consider osteologically in the present memoir constitute the Order Steganopodes of the Check List of the American Ornithologists' Union (1886, p. 106), where they are divided into the families *Phaëthontidæ, Sulidæ, Anhingidæ, Phalacrocoracidæ, Pelecanidæ,* and *Fregatidæ,* — a family arrangement adopted here. According to Reichenow the "Steganopodes" are an Order (IV.) of the Natatores, and contain but three families, the *Graculidæ, Sulidæ,* and *Pelecanidæ,*[5] while Dr. Stejneger arrays them as follows:

Order X.	Superfamily.	Family.
Steganopodes.	(XVI.) Pelecanoideæ.	Pelecanidæ.
		Sulidæ.
		Phalacrocoracidæ.
		Anhingidæ.
	(XVII.) Fregatoideæ.	
	(XVIII.) Phætontideæ.	

Professor Fürbringer, in his great work, places the "Steganopodes" (a Gens) in his Suborder Ciconiiformes, of the Order Pelargornithes, and divides them into the *four* families *Phaëthontidæ, Phalacrocoracidæ, Pelecanidæ,* and *Fregatidæ.* A still different arrangement is proposed by Mr. Seebohm, and the place they are supposed to occupy in the system according to his views will later on be given by me in my Osteology of the *Tubinares.*

Garrod has said "The *Steganopodes,* which do not form so natural a family, in my eyes, as in those of many; for their myological formula is not the same in all, being

In *Phæthon* A. XY,
In *Sula* and *Phalacrocorax* AX,
In *Fregata* A,

[5] **Die Vögel der Zoölogischen Gärten, 1882.**

from which it may be inferred that *Phaëthon* approaches the *Ciconiidæ* and *Fregata* the Accipitres. They all possess the ambiens, cæca, a tufted oil-gland, and the four toes included in a web, which is but imperfectly developed in some. *Sula* and *Phalacrocorax*, with *Plotus*, form one family, *Phaëthon* another, *Fregata* a third, and *Pelecanus* a fourth." (Coll. Sci. Mem., p. 221.)

Dr. Sharpe does not concur in this opinion, and in his "A Review of Recent Attempts to Classify Birds" (Budapest, 1891) places this group betwixt the Anseriformes and the Cathartidiformes, thus:

Order (XXIII.)	Suborders.	Families.
PELECANIFORMES.	Phaëthontes - - -	Phaëthontidæ.
	Sulæ - - - - - -	Sulidæ.
	Phalacrocoraces -	Phalacrocoracidæ.
		Plotidæ.
	Pelecani - - - -	Pelecanidæ.
	Fregati - - - - -	Fregatidæ.

In volume I of his "Hand List" (page 232), recently issued, this arrangement is somewhat changed. There the Pelecaniformes stand between the Ichthyornithiformes (Order XXII.) and the Cathartidiformes (Order XXIV.). They are then divided into the eight following families, viz.: 1. Phalacrocoracidæ. 2. Odontopterygidæ. 3. Plotidæ. 4. Sulidæ. 5. Fregatidæ. 6. Phaëthontidæ. 7. Pelecanidæ. 8. Pelagornithidæ. Of these 2 and 8 are extinct groups (1899).

Nearly a quarter of a century before Sharpe's work appeared Huxley in his P. S. Z. memoir (1867) had placed the steganopods in his group Dysporomorphæ of the Desmognathæ, and had said of them: "The rostrum is long and pointed and more or less curved, and the external nasal apertures are very small.[6] There are no basipterygoid processes. The palate-bones unite for a considerable distance behind the posterior nares, and send down a vertical crest from their junction."

"The maxillo-palatines are large and spongy. The angle of the mandible is truncated. The sternum is broad, and its truncated posterior edge is either entire or has a shallow excavation on each side of the middle line.

"The hallux is turned forwards or inwards, and is united by a web with the completely webbed anterior toes. The ratio of the phalanges is as in the preceding genera.

"The oil-gland is surmounted by a circlet of feathers.

[6] They are now known to be entirely absent in some of the genera as *Sula* and others.—S.

"This group answers to the 'Steganopodes' of Illiger; and since the appearance of the admirable memoir of Brandt, 'Zur Osteologie der Vögel,' in 1840, no doubt can have been entertained as to its extremely natural characters. The genera composing it are sharply divided by the structure of the skull, described above, into two groups — the one containing the Pelicans, the other the remaining genera" (pp. 461–462).

Doctor Hans Gadow makes an Order 9 — the Procellariiformes, and an Order 11, — the Falconiformes, — between which he places his Order 10, — the Ardeiformes. These last are thus characterized:

10. ARDEIFORMES.

Cosmopolitan Aquatic.
Young passing through a downy stage.
Oil-gland tufted. Aquito-cubital.
Humero-coracoid deep. No ectepicondylar process.
Desmognathous. No basipterygoid processes.

I. STEGANOPODES.

Cosmopolitan. Aquatic-nidicolous.
Piscivorous.
Rhamphotheca compound. Nares impervious.
No supraorbital glands. Angulare truncated.
Neck without apteria.
Legs short; all the four toes webbed together. (*Unique.*)
Hypotarsus complex. Flexors type of II.
Orthocœlous type II. Tongue rudimentary.

1. *Phaëtontidæ.*

15 cervical vertebræ.
Procoracoid process large.
Garrod's symbol AXY +.

2. *Phalacrocoracidæ* (including Sulinæ, Plotinæ, Phalacrocoracinæ).

18–20 cervical vertebræ.
Garrod's symbol AX +.

3. *Pelecanidæ.*

17 cervical vertebræ.
Procoracoid process small.
Garrod's symbol A +.

4. *Fregatidæ.*

15 cervical vertebræ.

Procoracoid process small.

Garrod's symbol A + .

II. Herodii.

Cosmopolitan. Waders. Nidicolous.

Zoöphagous. Bill long, pointed, laterally compressed, with simple rhamphotheca. Nares pervious.

No supraorbital glands.

Neck long, with long apteria.

Downs of adults only upon the apteria. (*Unique* among Ardeiformes.)

Legs long; four toes not webbed.

Hypotarsus complex. Flexors of type I. or VII.

Orthocœlous. Type II. Cæca rudimentary.

Tracheo-bronchial muscles attached to second bronchial rings.

1. *Ardeidæ.*

19 or 20 cervical vertebræ.

Several pairs of powder-down patches.

11 primaries. — Cosmopolitan.

2. *Scopidæ.*

16 cervical vertebræ.

No powder-down patches.

10 primaries. — Ethiopian.

III. Pelargi.

Cosmopolitan. Waders.

Neck long, without apteria. Nares pervious.

Rhamphotheca simple.

Legs long. Hypotarsus simple.

Intestinal type IV. telogyrous.

1. *Ciconiidæ.*

Zoöphagous. Nidicolous.

17 cervical vertebræ.

Hallux long, toes not webbed.

Flexors of type I.

Tongue rudimentary.

Cæca rudimentary.

Syrinx without Tracheo-bronchial muscles.

2. Phœnicopteridæ.
   Tropical. Nidifugous.
   18 or 19 cervical vertebræ.
   Hallux small, front toes webbed. Flexors of type IV.
   Tongue large and thick.
   Cæca functional.
   Syrinx with tracheo-bronchial muscles.

In 1889, as has been stated above, the present writer contributed some brief "Observations upon the Osteology of the Orders Tubinares and Steganopodes" to the Proceedings of the U. S. National Museum (pp. 286–314), and so far as the steganopodous birds were concerned there appeared in that article an illustrated account of the skeleton of *Sula bassana;* some remarks, also with figures, on the osteology of Cormorants and the Brown Pelican. That paper, with its figures, will be incorporated into the present memoir, but at this writing I am better off for osteological material wherewith to render a description of the skeletal characters of this suborder. My observations at this time are based principally but by no means altogether upon a study of the following skeletons and parts of skeletons.

List of Material.

Name.	Material.	Remarks.
Phaëthon flavirostris.	Perfect skeleton.	No. 17,841. Smithsonian collections.
Phaëthon æthereus.	Four perfect skeletons.	Author's collection. The gift of E. J. Reed Esq., of Guaymas, Mexico.
Sula bassana.	Skeleton nearly complete.	No. 16,643. Smithsonian collections.
Sula piscator.	Skeleton.	" 18,739. " "
Sula cyanops.	"	" 18,542. " "
Sula gossi.	Three complete skeletons.	Author's collection. The gift of E. J. Reed, Esq., of Guaymas, Mexico.
Sula brewsteri.	" " "	Author's collection. The gift of E. J. Reed, Esq., Guaymas, Mexico.
Anhinga anhinga.	Skeleton.	No. 18,259. Smithsonian collections.
Phalacrocorax urile.	"	" 18,982. " "
Pelecanus fuscus.	Skull and mandible.	Author's collection.
Pelecanus fuscus.	Skeleton.	No. 18,483. Smithsonian collections.
Fregata aguila.	"	" 18,485. " "

ON THE SKELETON IN PHAËTHON.[7]

Of the Skull, etc.—Of the two species of Tropic Birds, which we have to consider here, the red-billed one is the larger species, and this difference is quite apparent in their skulls, though in other particulars they are very much alike. In *P. æthereus*

[7] Dr. Sharpe, in his recent *Hand-List of Birds* (1899, Vol. 1, p. 238), recognizes the following species of *Phaëthon* as representing the genus throughout the world, viz: *P. rubricauda*, *P. lepturus*, *P. fulvus*, *P. americanus*, *P. æthereus*, and *P. indicus*. In this enumeration *P. americanus* and *P. flavirostris* are one and the same species.

the skull has an average length of about 10.8 centimeters, while in the other form, *P. flavirostris*, it equals for the same measurement but 9.2 centimeters. Measuring from the mid-point of the cranio-facial hinge, we find that in the yellow-billed species the length of the supero-mandibular portion of the skull exactly equals in length the cranial part, while in *P. æthereus* the facial portion slightly exceeds the cranial. Viewed from above (Plate I., Fig. 3), it will be seen that the supero-mandibular moiety is distinctly marked off from the cranium by the very distinct transverse cleft forming the cranio-facial hinge, which latter admits of considerable mobility in the dried skull. The upper osseous bill is broad and massive at its base, but almost immediately tapers as we proceed anteriorly towards its acute apex. The culmen is slightly decurved, while below the latero-external margins are cultrate. Just within these there runs a furrow nearly to the apex, which is bounded mesially by a raised bony ridge. Internal to this again, the central portion, is excavated, from the maxillo-palatines to the apex, being broad posteriorly and gradually tapering to the front. A delicate medio-longitudinal ridge

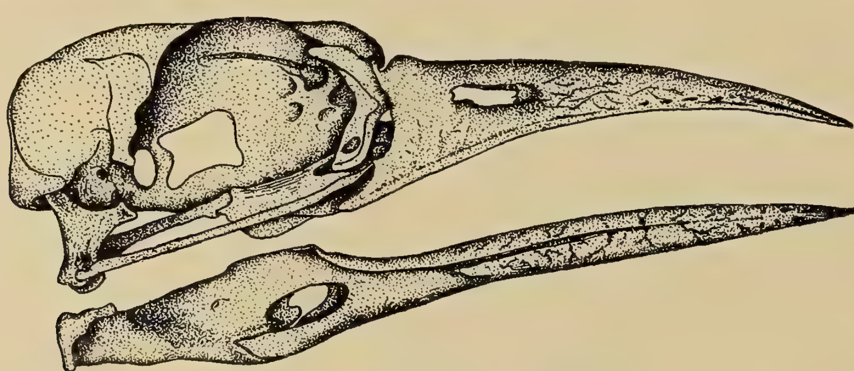


FIG. 1. Right lateral view of the skull of *Phaëthon æthereus*. Natural size. Drawn by the author from a specimen in his own collection.

marks the anterior half of this space, which is about equally well marked in the two species. In these birds there is always found a small foramen, perforating the mandible upon either side, just anterior to the lateral terminations of the cranio-facial cleft; while beyond these, the narial apertures, one upon either aspect of this osseous beak, are seen to be of no great size, being in form elongated, ellipsoidal, communicating, and with smooth, rounded margins. Minute marginal and culminar foramina occur in this part of the skull, while the intervening surface, or what is really the sides of the upper osseous mandible, is delicately scrolled over with fine anastomosing venations (Fig. 1).

The rhinal chamber is somewhat capacious, and the hollow part of this region, clear to the apex, is more or less filled in with bony tissue of the cancellous variety,

The cranium is broad and spreading behind, and but moderately narrowed anteriorly, and this form defines the shape of the superocranial aspect of the skull, where the smooth, rolling frontal portion is succeeded, as we pass backwards, by the flat and wide space that separates the sharp marginal borders of the orbits above. Slight parial elevations characterize the parietal region, and this surface falls away gradually, upon either side, towards the post-frontal processes. Deeply sculpt, the crotaphyte fossæ are mesially separated by a broad interval, smooth and unmarked. A remarkable feature of the skull of one of these birds, and it is still further enhanced when the lower mandible is articulated, is the appearance it has of having been vertically truncated in the transverse plane or direction, or being cut squarely across, reminding us of the skull in certain Herons and their allies.

Regarding the skull of a Tropic Bird, upon its lateral aspect, we are at first struck with the large, squarish orbit, bounded below by the straight, stout zygomatic bar; posteriorly by the massive quadrate, and the spreading post-frontal process; anteriorly, by the great, free lacrymal bone, with its projecting upper limb, and its vertical portion, which latter is twice perforated posteriorly by conspicuous pneumatic foramina. The interorbital septum invariably presents a large quadrilateral vacuity at its central surface, which is usually distinct from the orbital foramina posterior to it. A mere apology in bone represents the almost thoroughly aborted ethmoidal wing, or *pars plana.* The foramen for the exit of an olfactory nerve is exceedingly small as it occurs upon the anterior wall of the brain-case, and the groove leading from it is open; but the anterior foramen seen above the semi-aborted *pars plana* is of considerable size, and is usually completely surrounded by bone. In front, the margin of the mesethmoid is deeply notched, being produced below as a conspicuous, blunt-pointed process,—just the reverse, for example, of what we find in *Sula.*

Turning to the inferior aspect of the skull we meet with many points of interest, and a construction of parts by no means typically steganopodous (see Plate I., Fig. 2). In front the *maxillopalatines* are distinctly developed, being elegant concavo-convex processes, with their convex sufaces parallel with each other but not in contact mesially. Their concave external aspects are partially filled with a very open cancellous tissue of bone, and they have a broad base in each case, which appears in the adult skull to coössify with the corresponding nasal, maxillary, and perhaps, premaxillary. The postero-inferior angles of the latter are, upon either side, produced backwards as a prominent process which, when the lower mandible is articulated with the skull, outwardly overlaps its margin opposite to them.

The *palatines,* although in contact for their entire surfaces in the middle line, do not coössify as is the case in the Cormorants, Gannets and other steganopods.

Either one of this pair of bones is thickened, much cut away posteriorly, but broadly wedged in among the usual facial elements in front. Above they are moulded closely upon the rounded rostrum of the sphenoid, being drawn to a fine point anteriorly. It is along this line beneath that the palatines fuse with the *vomer*, an element which has much in its form to remind us of that bone in the *Laridæ*, being pointed in front, mesially carinated below, and grooved longitudinally along its upper surface. Laterally, the surface of a palatine looks almost directly outwards, and it is here that we invariably find one or more pneumatic foramina leading into the interior of the bone. A palatine head is large and offers an ample articulatory surface for the corresponding pterygoid. These palatal heads are closely pressed together, but in front of them, below, the bones send down in common only the merest suspicion of a midcarination, a character so common in *Pelecanus*, Cormorants, and other species of the suborder. The postero-external angle of a palatine can hardly be said to exist in the skull of this bird, as the bone so abruptly slopes away in that part of its body, as will be observed by referring to the figures in the plates.

The *pterygoids* are long, stout, straight, subcylindrical, rod-like bones, cupped at their extremities, and when articulated *in situ*, stand well above the basitemporal area. Not a semblance of such a thing as a basipterygoidal process is to be discovered upon either of them, or at the anterior borders of the basisphenoid. Anteriorly, their palatine heads articulate in contact with each other; their divergence from this point is at an angle of about 20°.

The basitemporal area is triangular in form with a small transverse ridge crossing its center. In front a broad, anteriorly rounded lip of bone underlaps the double openings for the internal carotid. So prominent in *Sula*, the paroccipital processes are here much reduced in size, and the hemispherical condyle is sessile and unnotched on its superior aspect. The foramen magnum is subcircular in outline, and is situated, as it were, in the middle of a shallow concavity.

A *quadrate* has an extensive anterior surface; transversely elongated, antero-posteriorly compressed, articular facet for the mandible; a double mastoidal head; and a broad, squarely truncated orbital process. This bone is also pneumatic, and its articular facet for a pterygoid is rounded and projecting. As in *Sula*, there is a very deep pit, of no mean size, immediately in front of the mastoidal process of either quadrate, and when those bones are *in situ*, they arch over the posterior thirds of these pits, in such a manner as to have, in each case, the outer mastoidal head articulate upon the outer border of this pit, and the inner head upon the inner border. Either one of these deep excavations is situated above and to the outer

side of the corresponding osseous opening of the ear, and the foramen ovale. Posteriorly the cranial surface, in so far as the occipital area is concerned, lies in the vertical plane, and is distinctly reniform in outline, bounded all about by a raised osseous ridge, with its convex curve above, and the foramen magnum situated mesiad in the concavity below. The unpierced supraoccipital prominence is fairly well-developed, and occupies the mid-vertical line of this reniform occipital area, extending from the foramen to the limiting curve above.

The *mandible* of a Tropic Bird is somewhat acutely V-shaped in form with large and deep articular cups for the quadrates. These cups have large pneumatic foramina in their concavities, with a single such opening on the upper side of their short inturned processes. Behind, they are vertically, as well as completely, truncated.

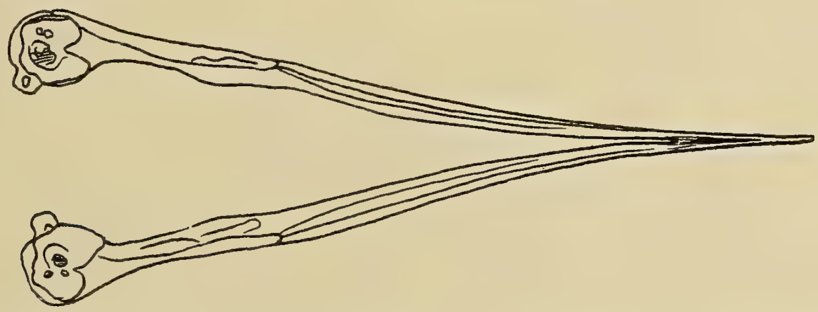


FIG. 2. Superior view of mandible of *Phaëthon æthereus*. Outline sketch, natural size, by the author from specimen in his private collection.

Either ramal moiety is very deep, and laterally compressed,—presenting, well forward of the articular end, a large, irregular ramal vacuity. The dentary portions of the mandible have hardly half the height of the ramal limbs; they are thickened, and each is deeply grooved for nearly the entire length of its superior margin. Anteriorly, they run very close to each other, and the terminal symphysis is deep, averaging in depth 1.5 cm. in *P. æthereus*, being nearly 2 cm. in some specimens. In an *eye* of the species just mentioned I count some 15 osseous sclerotal plates; they are remarkable for the extensive manner in which they overlap each other, and still more for the fact that the anterior ones have a depth of not more than one third of the posterior ones, a uniform graduation taking place in the intermediate plates, above and below, in this osseous circlet.

We find, too, an interesting structure in the bony parts of the *hyoidean apparatus* of *Phaëthon*. In the adult, the ceratohyals have fused in ossification with the posterior half of the glossohyal to form a peg-like bone, which is longitudinally grooved above and convex below. The first basibranchial is a short, thick piece, expanded in front to form an articular facet, while behind it supports the very minute, though

free, second basibranchial. Either ceratobranchial is an extremely long, slender rod of bone, bearing at its distal end a little bit of an epibranchial, which latter is finished off posteriorly by a thread-like extension in cartilage. Cartilage also tip the glossohyal in sfront, and laterally, the ends of the ceratohyals may not entirely ossify.

For the *trachea,* its rings seem to be performed in elementary osseous tissue only, and in mid-course of this tube, they are delicate structures, being markedly narrow in depth, and very frail.

Of the Axial Skeleton.—(See Plate XXI., Figs. 5 and 6.) Representatives of the genus *Phaëthon* possess in the cervical and cervico-dorsal divisions of the vertebral chain 15 bones. Three of these are cervico-dorsals, the anterior one of which always supports an exceedingly rudimentary pair of free riblets.

In *P. æthereus* they are seen to be in the same condition on the next following vertebra, or the 14th vertebra of the neck, while in *P. flavirostris* they are of some considerable length, though they do not develop epipleuræ. Both species have a well-developed pair of ribs on the 15th segment of the neck vertebræ, that support epipleural spines on their posterior margins, to which part they are firmly coössified.

The *atlas* is comparatively small with rather slender neurapophyses. Its cup is profoundly notched above, for the accommodation of the odontoidal process of the axis. Below, it develops a low hypapophysial spine projecting backwards, which, when the bones are articulated *in situ,* underlaps the centrum of the second vertebra. A prominent, quadrate hypapophysis also is found to exist beneath the centra of the axis and third vertebra, but this feature is very nearly aborted on the fourth cervical.

On the *axis vertebra* we find a massive neural spine, with conspicuous lateral projections, each jutting upwards and outwards from above the postzygapophyses. All these characters are moderately reduced in the third vertebra, while in the fourth the neurapophysis is very much reduced in size, and the aforesaid lateral or anapophysial processes are all but absent.

The lateral vertebral canals are but semi-closed in the axis; they are thoroughly so throughout the rest of the vertebral chain until we meet with the leading cervico-dorsal, wherein the existence of a pair of rudimentary free pleurapophyses leaves these canals open.

On the under side of the cervicals, the passage for the carotid canal is seen to be wide open, and is confined to the 5th, 6th, 7th and 8th vertebræ. Throughout the series, beginning with the third cervical, we find the parial backward projecting spines of the parapophyses to be pointed, and exceedingly stumpy and very short.

On the 9th a median hyapophysis makes its appearance, which is larger on the 10th, more quadrilateral in form and laterally compressed on the 11th, small on the

12th, and still more so on the cervico-dorsals, where there coexists with it the barest suspicion of lateral spines.

Viewed dorsad, the third cervical appears to have a quadrilateral form, which passes to the more oblong shape in the fourth, and the bones of this part of the column commence to shorten antero-posteriorly with sixth, they being wider than they are long for the remainder of the spinal series. The last two cervico-dorsals develop a low, quadrilateral neural spine, which resembles, but is antero-posteriorly shorter than the same process as it occurs throughout the dorsal vertebræ.

P. flavirostris has a delicate, osseous, interzygapophysial bar, extending from the back of either prezygapophysis backwards and inwards to the corresponding anterior bases of the postzygapophyses, in the fifth, sixth and seventh cervical vertebræ. Usually it only ossifies in the fifth and sixth in *P. æthereus*, its place being taken by ligament in the seventh and eighth. No such character as this is ever present in any of the *Sulidæ*. Strong and broad diapophysial processes are first pronounced in the first and second cervico-dorsals; in the last cervico-dorsal these processes are markedly shorter and shallower, while throughout the dorsal series of vertebræ they are decidedly slenderer, and in their vertical diameters of very little thickness.

Passing to the dorsal series of vertebræ, we find in *P. flavirostris* six of those bones freely articulated with each other between the last cervico-dorsal and the leading one in the consolidated pelvic sacrum. This last-mentioned vertebra, in all my specimens of *P. æthereus*, coössifies with the anterior sacral, though, as we shall see presently, this difference does not affect either the number or the arrangement of the thoracic ribs. Hypapophyses are fairly well developed upon all the dorsals of the middle of the back, but they become small as we near the pelvis, to be very inconspicuous or entirely absent from the last one or two bones. Pneumaticity characterizes all the vertebræ between the atlas and the first caudal, and the centra of the dorsals are but moderately compressed in the transverse direction. They present the usual ornithic plan of articulation with each other, and the same may be said of the manner in which the true *ribs* are connected with the segments of this division of the spinal column. There are *five* pairs of these ribs that bear *uncinate processes*, firmly attached to the middle of their hinder borders, and each pair of these appendages is slender, slightly overlapping the succeeding rib in every case save the last, which may or may not be of sufficient length to do so. As for the ribs themselves, they, too, are long and narrow, sweeping well backwards, a fact that entails the presence of lengthy hæmapophyses to reach the sternum. These latter are of no great caliber; the first pair being nearly straight, and the succeeding pairs becoming gradually more curved as we approach the last ones, which are the most

so. Finally, there are two pairs of thoracic ribs that are devoid of unciform processes, the costal ribs of the first of which reach the sternum, but those of the ultimate pair fail to do so by some considerable distance in both species. From what has been said in a foregoing paragraph, it will be seen that this gives one true pair of "pelvic ribs," while the penultimate pleurapophyses and their hæmapophyses in *P. flavirostris* articulate with a vertebra of the dorsum which is free, but which in *P. æthereus* is coössified with the pelvic sacrum. So were we to have studied skeletons of the latter species only, it would have been said that it possessed *two* pairs of "pelvic ribs," and had *P. flavirostris* alone been examined in this particular, the descriptive osteologist would have recorded but one pair. This is but another instance exemplifying the great necessity of having the proper material in sufficient variety before one for comparison.

Viewing the *pelvis* from above, we find that the anterior margins of the ilia overlap the penultimate pair of thoraric ribs in the Red-billed Tropic Bird, not so, however, *P. flavirostris;* and this, taken in connection with the apparent appropriation on the part of the sacrum of one of the dorsal vertebræ, already referred to above, in the case of the first-named species, lends to the pelvis a difference of appearance in the skeletons of the two birds, now under consideration, which is not otherwise particularly borne out by this bone. In part, the pelves of these specimens are otherwise very much alike. Disregarding, then, the vertebra to which reference has just been made, we find the *sacrum* to be composed of *ten* others, which are thoroughly fused together and with the ilia, one upon either side. Taken as a whole, the pelvis is broad, not especially long, and very shallow and compressed in the vertical direction. The internal borders of the ilia are nearly parallel to each other, and the broad sacrum keeps them well apart for their entire length. Such an arrangement, as we might expect, gives open, shallow "ilio-neural grooves," one on either side of the sacral crista, anteriorly. These are quite continuous with similar "groovings" carried back posteriorly as far as the first caudal vertebra. In other words, between the inner borders of either ilium, and the supero-median line of the sacrum, the diapophyses of the vertebræ are found to be below the general surface; while between them, for the entire length of the pelvis, occur foramina of some size, and more or less subcircular in outline. These single parial rows of interdiapophysial foramina constitute a striking character upon the superior aspect of the pelvis of the Tropic Birds, inasmuch as in the preacetabular portion of that bone in *Sula, Plotis*, the Pelicans, and the Cormorants, they are out of sight on this aspect by the internal margins of the ilia meeting the sacral crista. Thus it will be appreciated that the breadth of the pelvis in *Phaëthon*, to which allusion has been made, is

chiefly due to the broad sacrum, and not to the ilia, which bones, either in their pre- or postacetabular parts, are quite narrow in their transverse direction. The former area, in each one, being very slightly concaved, and in the latter, barely convexed. Antitrochanterian processes are comparatively prominent, and each overhangs a cotyloid cavity of moderate size, and of the usual ornithic character. Laterally viewed, we note that the *obturator foramen* is complete, due to the fact that either pubic style is in contact for nearly its entire length with the inferior margin of the corresponding ischium. This obliterates anything like an obturator space. Each *pubic style* is long and somewhat slender, and often passing an ischium behind, curves downwards and very slightly inwards. Here the bone is appreciably dilated in *P. æthereus*, which is not the case in the other species we are considering. An *ischium* is also narrow, and projects some distance beyond the ilium of the same side. A very shallow ilio-ischiac notch, on the posterior pelvic border, is formed by this arrangement; but by no means as well marked an one as we see in the more typical steganopods, to be described later on in this memoir.

The ilio-ischiac foramen is large and of a subelliptical outline (see Fig. 6, Pl. XXI.). On the under side of the pelvis in *Phaëthon*, we are to note the fact that the sacral vertebræ, opposite the acetabula, do not throw out their processes to act as braces to especially strengthen the ilio-pelvic walls at those points, a feature often seen in the skeletons of other birds, and, as before found, both by Mivart and myself, to be the case in *Pelacanus*, the true cormorants, in *Sula*, and to a somewhat less conspicuous degree in *Anhinga*.

Eight free *caudal vertebræ*, plus an elongated, ploughshare-shaped *pygostyle*, go to make up the skeleton of the tail in a Tropic Bird. These vertebræ have spreading diapophyses, especially the fifth one, and all have neural spines, while the last three of them possess bifid hæmal spines; and this last character is impressed upon the lower end of the coccyx. The neural canal passes through the entire series. From this, and including the coccygeal piece, it will be seen, from our account of the spinal column, as it has been given above, to contain in these birds, forty vertebræ. They are all pneumatic, except the atlas and those which go to form the skeleton of the tail.

The Sternum.—This bone in my specimen of *Phaëthon flavirostris* has a body of a quadrilateral form, being almost as wide as it is long. Its carina is deep anteriorly, where it protrudes far forwards, while behind it merges with the ventral surface of the body at some distance before it reaches the mid-xiphoidal process. In front the carinal angle is thickened, and upon its superior aspect there exists a considerable facet for articulation with infero-median surface of the *os furcula*. This facet is not at the apex, but is found about one third the distance back towards the sternal body,

and the articulation, though very close and extensive, is free, and anchylosis has never been seen by me to take place between the two bones. The *coracoidal grooves* decussate, the median extremity of the right one passing beneath the median extremity of the left. A very rudimentary manubrium is seen immediately below this point, and below it a circular pneumatic foramen. Either *costal process* is broad and subtriangular in form, and upon either costal border occur six facets for articulation with the hæmapophyses which connect the sternum with the vertebral ribs. On the much-concaved sternal body, just within the anterior border in the median line, dorsad, there runs back longitudinally a characteristic bridge of bone, upon either side of which we find a large subelliptical pneumatic foramen, and usually they are the only two found in this situation. Other small ones occur, however, in the pitlets among the hæmapophysial facets on the costal borders. Very broad external xiphoidal processes of the posterior part of the sternal body, extend further backwards than any other part of the bone; the middle xiphoidal process is broadly rounded. The internal pair of processes are small and delicate, and each one of the pair occupies a mid-point in the great, round notch, on either side, existing between the mid- and external xiphoidal process, thus creating a 4-notched sternum for this species, of a peculiar pattern in this respect. Mivart has said in his "Axial Skeleton of the Pelecanidæ" (T. Z. S., p. 365), that "in the *Pelecanidæ* there is but a single lateral xiphoid process on each side, while in *Phaëthon* there are two on each side, in addition to the median xiphoid process." Farther on we shall see that this by no means always holds good for *P. æthereus.* Passing next to the consideration of the sternum in the species last mentioned, we observe that in the majority of its characters it agrees with the bone as it has just been described for *P. flavirostris.* It is proportionately larger however, and presents two striking differences. In the first place, in all four of my specimens a large, blunt-pointed manubrium is present, which is transversely pierced at its base by a foramen. Again, the internal pair of xiphoidal processes may be entirely absent, or only one may be present on one side, and when such is the case, it appears only as a minute projection from the inner border of the external xiphoidal process *near its extremity.* I have no specimens of the sternum of *P. æthereus* wherein there is to be found a *pair* of internal xiphoidal processes, and consequently its sternum is not four-notched as in its cogener, *P. flavirostris.* More or less minute or scattered pneumatic foramina may be found on its thoracic surface, above the two large ones which occupy similar positions to those noticed in the Yellow-billed Tropic Bird.

The *os furcula* is of the broad U-shaped pattern, with its median portion below, widened, and on the under surface of which occurs the facet for articulation with the

keel of the sternum as described above. The upper free extremities of the clavicles are drawn out, rounded, blunt-pointed and the apex of each one, when articulated *in situ*, reaches back, on either side, to the antero-mesial angle of the corresponding scapula.

A *scapula* is long, very narrow, rounded, and somewhat compressed in the vertical direction. Its distal end only is blade-like, very slightly expanded, and obliquely truncated from a point within to the apex. It articulates in the usual ornithic manner with the coracoid, and neither it nor the os furcula appear to be pneumatic, as is the *coracoid.* This latter bone of the shoulder-girdle has a broad, much expanded sternal extremity, which supports a moderately prominent lateral coracoid process. The entire length of the bone is greater than half the length of the humerus, and its shaft is compressed in the oblique antero-posterior direction. Its head or summit is tuberous, and also somewhat compressed in the same plane with the shaft. The process for articulation with the os furcula is large, much flattened from side to side, and low down in the deep tendinal groove it creates, we observe a minute antero-posterior perforation of the bone. As usual, the coracoid and scapula form a well defined *glenoid cavity* for articulation with the head of the humerus. An *os humero-scapulare* is not found.

Of the Appendicular Skeleton. The Pectoral Limb: Apart from the mere matter of the difference in size, the bones composing the limbs in the skeletons of these two species of *Phaëthon* are in their corresponding characters almost exactly alike, and these again are notably different from those same characters as we find them exemplified in the limb-bones of the skeletons in other families of the Steganopodes. These departures will be noted from time to time later on in this paper, after the present account of the osteology of the Tropic Birds has been written.

In the brief subjoined table some of the lengths of the bones are compared, the measurements being given in centimeters and fractions.

TABLE.

Measurements. taken from extreme distal points, and not on curved contour lines.	Species.	
	P. flavirostris.	*P. æthereus.*
Length of humerus.	8.4	9.3
Length of ulna.	8.9	9.7
Length of carpo-metacarpus.	4.3	4.8
Length of proximal phalanx of index digit.	2.5	2.9
Length of distal phalanx of index digit.	2.4	2.8
Total length of pinion (articulated).	8.8	10.1
Length of femur.	3.2	3.7
Length of tibio-tarsus.	4.7	5.3
Length of tarso-metatarsus.	2 3	2.8
Length of mid anterior toe.	3.8	4.2

From this it will be seen that both the proportionate and relative lengths of certain long bones of the limbs in these two species of birds slightly differ, but the difference is very slight.

There is no especial association of characters in either the pectoral or pelvic limbs of *Phaëthon* that in any way remind us of the corresponding parts of the skeleton in a Gull, or a Tern, much less any kind of an Auk or a Puffin. The several bones seem to possess a distinctive character quite their own. The *humerus* shows a slight compression in the transverse direction, rendering its humeral head narrow, and its very moderately curved shaft ellipsoidal rather than circular on section. The well-marked ulnar tuberosity projects directly anconad, as does the prominent radial crest project palmad,—the long transverse axis of the first being parallel to the plane of the latter. At the proximal end of the bone, on its palmar aspect, just before we come to the humeral head, we meet with a well-defined groove running at right angles to the long axis of the shaft; and this groove becomes very deeply marked at a point on the opposite side of the bone from the ulnar tuberosity.

The "pneumatic fossa" instead of being entirely open, as in a good many birds, is covered across by a more or less perfect bony plate, which plate shows the single, circular pneumatic perforation at its center. This hole is smaller in proportion in my specimen of *P. flavirostris* than it is in the other species. At the distal end of the bone the fossa above the *oblique* and *ulnar* tubercles is fairly well scooped out; while on the ulnar side of the humerus at this end, both the pits for tendinal insertion and the grooves for their passage are unusually well marked and deep. An exceedingly rudimentary "epicondyloid process" can be seen, but it by no means is the characteristic feature that we find it to be in the humeri of the *Laridæ* and those suborders of birds most nearly related to them.

The *radius* is straight and of a more or less uniform caliber, while its companion bone of the antibrachium, the *ulna*, is considerably bowed, with its shaft presenting three faces more or less distinctly. These might be here designated as a palmar face or surface, an interosseous face, and a subanconal face. The line or angle formed by the intersection of the subanconal and palmar faces, has along it the row of papillæ of the secondary quill-feathers; and another indistinct row of them passes down the middle of the subanconal surface. There are fourteen such papillæ in the first mentioned row. The olecranon process is a very insignificant affair, while at the distal extremity of the bone, at its anconal side, the end is drawn out into a distinct apophysis, which, in articulation, bends down towards the *ulnare ossicle* of the wrist. Two segments compose the skeleton of the carpus in the adult, the usual *radiale* and the just-mentioned *ulnare.*

Carpo-metacarpus presents us for examination the ornithic characters common to many representives of this class of vertebrates. The coössified pollex metacarpal is of average size, and the slender shaft of the medius metacarpal is, for the greater part of its continuity, parallel with the far heavier shaft of index. This last, at the anterior aspect of its distal end, develops a pronounced little process, which serves to retain in their proper groove, the tendons which pass in that region during the life of the individual. The free digit of pollex has the usual form seen in *Aves* generally, and the expanded posterior portion of the proximal phalanx of the index finger is entire, and not perforated as we find it in many of the *Laridæ*. The distal joint of this digit is long and slender, being once semibarbed near its lip, the projection standing out from its posterior angle. Long and spine-like, the free joint of medius is seen to be proportionately more slender in the Red-billed than it is in the Yellow-billed Tropic Bird. There do not appear to be any free terminal ungual joints at the ends of any of the fingers in these birds; and I have found no small sesamoidal bones either about the carpus or near the elbow joint.

The humerus alone of the bones of the pectoral limb is pneumatic.

Passing to the consideration of the *pelvic limb*, we find that the *femur* too, is generally a pneumatic bone, and is peculiar inasmuch at the foramina occur irregularly at the proximal end of the shaft either *in front* or *behind*, while in *P. æthereus* a single, circular pneumatic foramen is found in the majority of skeletons in the popliteal fossa near its center. For its proximal moiety, tibio-tarsus may likewise be hollow, and, in life, air gains access to its interior. In one of my specimens a small perforating foramen is seen between the low cnenial crests very near the summit of the bone. Below the point indicated, the remainder of the skeleton of the pelvic limb seems to be non-pneumatic.

The axis of the head of the femur makes a wide obtuse angle with the longitudinal axis of the shaft, and the pit for the insertion of the *ligamentum teres* is but very faintly marked upon the top of it. On the summit of the bone we find the usual articular surface, and above this the trochanterian crest is scarcely at all elevated. At the proximal end of the shaft, between the great trochanter and the *caput femoris*, a very appreciable fossa exists, and immediately below this a very distinct tubercle presents itself in a great many specimens especially of *Phaëthon æthereus*. It at once reminds one of the *trochanter minor* of the mammalia, and no such a character is ever to be seen upon the femora of any of the other steganopodous birds judging from those before me, and I do not now recall ever having seen it upon the femur of any other existing or extinct bird. This character is but faintly seen in the U. S. National Museum specimen of the skeleton of *P. flavirostris* (No. 17841).

At the distal end of the femur the condyles are not very prominent, and the internal one is small. Nor is the rotular channel or the popliteal fossa deep, but on the contrary they are both shallower than in many other birds known to me. We find the shaft in *tibio-tarsus* to be straight and nearly cylindrical. Proximally, the low cnemial process rises but a little above the summit of the shaft, while anteriorly, below it, the pro- and ectocnemial ridges are but very inconspicuously developed. It is between these latter that the small pneumatic foramen usually is seen. Distally the usual characters of this bone are to be observed; the osseous span to confine tendons, at the antero-distal end of the shaft is present, and passes in a slightly oblique direction over the channel it bridges; the condyles, with their usual reniform contour, are well separated from each other, and the intercondyloid notch between them, is marked in front, but very shallow behind. In the *fibula* we see a very slender and rudimentary bone. Especially is this the case below the 'fibular ridge' on the side of the shaft of the bone it articulates with, for it is then reduced to little more than a flattened osseous hair, closely applied to tibio-tarsus, but apparently never actually anchyloses with it.

Phaethonidæ always possess a *patella* in front of the knee-joint, and it is of an elongated form, being flat behind and convex in front, where it is distinctly marked in the transverse direction by the groove for the tendon of the *ambiens* muscle.

Most remarkable of all the bones of the pelvic limb in *Phaëthon*, however, is its *tarso-metatarsus*. To describe this I select the left one from one of my skeletons of *P. æthereus*. The bone is oblong in outline; much flattened in the antero-posterior direction; and with its middle trochlear process but slightly lower on the shaft than the internal one, which latter in turn is but a little lower than the outermost one. On the summit, the shallow articular depressions for the condyles of the tibiotarsus are separated by a rounded eminence in front. At the back of the shaft, in this region, we find the "hypotarsus" to consist simply of three vertical ridges,—a short, small middle one, with longer and stouter outer ones. Anteriorly, the shaft of the bone is deeply scooped out from above, downwards for nearly its entire length. On the outer side below, this channel terminates in an antero-posterior perforating foramen,—situated at a point a little above the notch dividing the mid- and outer trochlear processes. On the *inner* side below, there is a small, longitudinally-disposed groove that runs into the main excavation on this aspect of the shaft at about its middle. This smaller groove also terminates below in an anteroposterior perforating foramen,—situated at a point a little above the notch dividing the mid- and *inner* trochlear processes. Thus we see in *P. æthereus*, there are *two* antero-posterior perforating foramina at the distal extremity of its tarso-meta-

tarsus; — a very rare condition in existing birds, and even *absent* in *P. flavirostris*, where only the usual *outer* foramen seems to be present.

At the back of the shaft there is a low median ridge running down from the lowermost point of the hypotarsus to bifurcate below. One limb is lost on the posterior surface of the mid-trochlear process, the other on the outer one, while between them occurs the outer of the two perforating foramina just described above. Upon either side of this ridge, the shaft upon this aspect is also grooved in the longitudinal direction, but not so deeply as it is in front. Placed side by side in the anterior groove of the bone, just below the head, we find a pair of perforating foramina. They make their exit one upon either side of the lower part of the hypotarsus behind; each one lying in a postero-longitudinal groove, to which mention has just been made in the last paragraph. The sides of the shaft of this bone of the leg are more or less flattened, and the tubercle for the insertion of the *tibialis anticus*, is very small. The *first metatarsal* is free, being long and flake-like, and articulates by its entire outer margin, with the postero-internal edge of the shaft of the tarso-metatarsus. *Pes* has what is usually termed the normal arrangement and number of joints to the several toes, *i. e.*, 2, 3, 4 and 5 joints, to the hallux, second, third and fourth digits respectively. Exceedingly slender and long, the basal joint of hallux is tipped off with a small, slightly curved ungual phalanx. The terminal phalanges of the three anterior toes are relatively much stouter, thicker, but exhibit about the same proportionate amount of curvature. With respect to the shafts of the intermediate joints, it is to be noted that they are long, slender, and exhibit but very little curving; while the articular ends of these bones are but very slightly enlarged. Indeed, the skeleton of the foot in the *Phaëthonidæ* is in reality delicately constructed.

TABLE.

Toes and their joints.		*P. flavirostris.* Measurements in mm.	Remarks.
Hallux or First Toe.	Basal joint	11	From this it will be seen that the length of the skeleton of the middle toe is about ⅗ the length of the tibio-tarsus. On the other hand it is longer than either the femur or the tarso-metatarsus.
	Ungual "	4	
Second or Inner Toe.	Basal "	15	
	Second "	12	
	Ungual "	5	
Third or Middle Toe.	Basal "	12	
	Second "	11	
	Third "	10	
	Ungual "	5.1	
Fourth or Outer Toe.	Basal "	10	
	Second "	8	
	Third "	8	
	Fourth "	8.5	
	Ungual "	4	

A proportionate increase in their length and caliber seems to be the only important difference that distinguishes the skeletal toe-joints of *P. æthereus* from the corresponding bones in *P. flavirostris.* To show the relative lengths of the phalanges in the last named species, see the above table, in which the measurements are given in millimeters.

Beyond the patella, already described above, I find no other sesamoids associated with the bones of the pelvic limb in the *Phaëthontidæ.*

Osteology of the Sulidæ.[8]

(See Plates XXII. and XXIII., Figs. 7-12.)

Of the Skull.—*Sula bassaua* has a skull that averages in the adult about 186 mm. in length; whereas in *Sula piscator* 129 mm. is the average length of the skull in the adult. Between these extremes we find the other species to fall, and a simliar variation is size is, of course, applicable to the remainder of the skeleton in these different specific forms of the *Sulidæ.* Apart from this, the characters presented in the skeletons of these birds in the main agree very well indeed, though differences do exist, and these stamp the skeleton of each species with an individuality peculiarly its own. The more important of these differences will be noted as we proceed. (See Plates XXII., XXIII., Figs. 7-11.)

In form, the superior osseous mandible is flat upon its under side with cultrate tomia, while superiorly it is convex from side to side, and tapers from base to apex gradually to a point, being a little decurved near the extremity. Sometimes we find it pierced by a foramen on this upper side, which leads to its hollow interior, but *Sula* is without nostrils, though did they exist, their position would perhaps be indicated by the posterior end of the longitudinal furrow that marks the mandible upon its lateral aspect.[9]

An osseous, thoroughly adherent crust, appears to overlay the greater part of the superior surface, the only smooth place being a small area in front of the craniofacial hinge, and even this is absent in *Sula piscator* and other species. Its entire surface is marked all over by an exquisite anastomosing venation, the ramifications

[8] Besides some four fossil forms, Dr. R. Bowdler Sharpe in his recent *Hand List of Birds,* recognizes the following species of the genus *Sula,* in which are included all the birds of this group at present known to ornithologists:—viz: *S. bassana, S. serrator, S. capensis, S. cyanops, S. abboti, S. piscatrix, S. websteri, S. variegata, S. nebouxi, S. sula* and *S. brewsteri.* In the A. O. U. "Check-List" we also find *S. gossi,* which may correspond with one of the species above enumerated, as *S. nebouxi,* or *S. websteri.*

[9] In my memoir entitled "Observations upon the Osteology of the Orders Tubinares and Steganopodes (Proc. U. S. Nat. Mus. Vol., XI., 1888, pp. 253-315), I give figures of all the principal bones of the skeleton of *Sula bassana,* drawn by me, natural size, direct from the specimens. These will not be reproduced here, while the osteology of other species of Gannets will be illustrated in the plates of the present memoir, as *S. gossi* and *S. brewsteri.*

starting, in some instances, from minute foramina found upon its surface. This venation is but feebly marked in *S. piscator*.

A *lacrymal* is a free bone, articulating with a roughened facet of some extent beneath the antero-external angle of the frontal above, and by a smooth, gliding facet on the upper side of the maxillary, which latter bone is thickened in a perpendicular direction and otherwise enlarged in order to offer it the proper amount of surface. As for the bone itself, it is of rather a columnar form, with the exception of its extended anterior margin, which is roundly notched and shows on its inner side the large pneumatic opening leading to its hollow interior. In *S. cyanops* this notch is extended as a groove entirely across the outer face of the bone, and the pneumatic foramen is seen in this groove.

In Gannets there exists, projecting horizontally from the outer margin of the frontal bone, on either side, from its "prefrontal process," a few millimeters posterior to the fronto-lacrymal suture, a small rounded ledge of membrano-cartilage, which reminds one of the horizontal portion of the true lacrymal bone in certain gallinaceous birds, as the *Perdicinæ*, for example. This feature has been studied by me in *Sula brewsteri* and *S. gossi*, recently killed specimens for which I am indebted to Mr. E. J. Reed of Guaymas, Mexico, who kindly collected them for me. This membrano-cartilaginous process probably never ossifies in the *Sulidæ*.

In the adult bird it is impossible to distinguish the exact position, or any of the borders, of the nasal bone.

The maxillo-jugal bar shows very plainly the suture between the jugal and quadrato-jugal; the latter is much smaller than the other portion, and shows a strong peg-like process upon the inner aspect of its posterior end, which is about at right angles to the axis of the bone. It fits in the deep conical socket on the side of the quadrate. Beyond its enlargement for the lacrymal the maxillary is a thin, horizontal plate of bone, anchylosed in the usual way at its anterior end. Here it really enters into the apparatus of the cranio-facial hinge. An ossicle having the appearance of a process pointing backward and apparently coming from the premaxillary is seen over this horizontal plate of the maxillary on either side. Professor Parker found this condition present also in another species of *Sula*, and this eminent anatomist apparently describes this ossicle as a "post-maxillary" for those birds. Either rudimentary or better developed, it is probably present in one form or another in all of the *Sulidæ*.

The interorbital septum, which is a thin, smooth plate, shows considerable of a fenestra near its middle, and a few such openings of a very much smaller size pierce its posterior wall in *S. bassana*.

The orbital cavity itself in Gannets is very deep, the eaves of its roof almost overhanging the jugal bar beneath. Its superior periphery is smooth and rounded. All in front of the rhinal chamber is filled in by the spongy mass formed by the united maxillo-palatines. The hinder portions of these bones are, however, still distinct in *S. bassana,* and they have all the appearance of these elements as they are found in birds which possess them as concavo-convex plates facing outward.

The rostrum of the sphenoid is a hollow subcylindrical tube, united above with the interorbital septum. As we proceed anteriorly it becomes more flattened from side to side, and gradually rises upward. At a point about half way between the palatines and cranio-facial hinge it terminates in a process directed forward; above this is the sharpened ethmoidal margin, nearly perpendicular to the long axis of the skull. Osseous wings to the ethmoid never develop in *Sula,* not even rudimentary traces of them being seen at their customary sites.

The cranio-facial hinge is exceedingly perfect in its construction, being composed of a thin plate of bone occupying the full width of the skull; the bones both above and below are separated from each other by a small interval for the entire length of the transverse line constituting the hinge. The part played in the mechanism by the maxillaries has already been described above.

We find the sphenotic process to be more or less bifid and jutting directly out from the side of the skull; on the other hand, the mastoidal process is a crest of bone curling forward. Between these two the very wide crotophyte valley is seen.

The quadrate is a large, massive bone, with its mastoidal head composed of two prominent ellipsoidal trochleæ, separated from each other by an intervening notch. Below these the shaft is seen to be rather compressed in an antero-posterior direction, and supports in front at its lower half an unusually formed orbital process. This is a thin, triangular plate of bone placed in the vertical plane, and with its apex directed forward. The pneumatic foramen of the quadrate usually occurs on the posterior aspect of the shaft in most birds, but here it is situated to the inner and lower side of this orbital process. In *Sula cyanops* I find two others on the anterior aspect of the bone, one near each articular process.

The pit for the quadrato-jugal is cylindrical and deep, and a perforation at its bottom may lead into the hollow of the bone. On the posterior aspect of the quadrate we find an irregular facet for the mandible; it looks directly to the rear and stands at the head of a longitudinal and deep groove which is found between two similarly placed facets on the foot of the bone.

Each pterygoid is a trihedral and compressed bone with prominent borders.

Regarding this skull from a superior view, we see in it a foramen in the superior mandible, near the site of the narial opening of the majority of other birds. From this aspect we also have a good view of the wonderfully perfect cranio-facial hinge of this bird.

Posterior to this is a broad, smooth area, very slightly convex, and showing in some species numerous venations like those on the bill of *S. cyanosis.* This surface extends from the cranio-facial hinge to the anterior border of the crotaphyte fossæ, while laterally it is bounded by the margins of the orbits.

This view also shows the extent and form of these crotaphyte fossæ, and how they are separated from each other in the median line, simply by an extension backward of a very narrow strip of the general surface that lies beyond them. They merge with each other in some specimens of *S. piscator.* They are bounded behind by conspicuous and sharpened crests that curl slightly forward, and are best marked laterally, becoming very low as they near the upper part of the supra-occipital prominence.

The under view of the skull reveals a number of interesting points. We find that the anterior portions of the palatines are parallel to each other, separated by a median cleft of a width equal to either one of them, and which becomes pointed behind.

Their anterior ends do not merge into the premaxillary beyond until they are well past the points where the maxillaries are inserted. These anterior portions are thin, horizontal plates, being directly continuous with the horizontal and fused palatine bodies behind. This latter portion shows a small median carination just in front of the united heads, and the postero-external angles are rather sharp, being pointed directly backward.

Anteriorly, the pterygoidal heads meet each other and the fused palatines, the three forming a groove on their upper sides for the rostrum. At their outer ends each pterygoid offers a shallow cup to form the usual articulation with the quadrate of the corresponding side.

Professor Parker found that "in *Sula alba* the basitemporals are as little developed as in the *Dromæidæ,* less than in any other carinate bird. Behind each moiety there is a large oval opening, not far in front of the occipital condyle; this exposes the loose diploæ within. The small Eustachian tubes open at a little distance from each other, in a wide, shallow fossa, on the part where the three elements of the parasphenoid meet." The description of these details agrees with the skull of the specimen before me. Professor Parker, however, was fortunate in having the skeleton of the ear-parts in his specimen, and, of them, he says that "in *Sula alba,* the

columella auris is very long and bent. It has a small, cartilaginous, extra-supra-stapedial process, and a long, attenuated stylohyal."

On either side, the entrance to the middle ear in *Sula bassana*, as in others of the same genus, is shallow, and it is situated quite internal to the quadrate bone, while immediately mesiad to it there is a pit of great depth, with its aperture looking downwards, and its base in the vault of the cranium, which seems designed for muscular lodgment; the positions of the usual foramina about it are peculiar, and extremely interesting in these birds.

The bony wings that shield the entrance to the ears are large and tilted up behind. Each one shows the double facet for the mastoidal head of quadrate, the outer one having its inner margin encroached upon by the pit described above.

The postero-internal angle of either of these wings is connected with the side of the elevated basi-temporal region by a bony bar. This condition can best be seen from a posterior view. When speaking of the orbital cavity I neglected to mention that the upper part of the septum is longitudinally marked, as in most birds, by an open, single groove for the passage of the olfactory nerve to the rhinal space beyond. The exit for it from the brain-case is very small, indeed, and occasionally, in *S. bassana*, on one side, the bone spreads over it, rendering the nerve track, for a fraction of the initial part of its course, tubular.

The brain-box itself is capacious and notable for its great width over its compression in the vertical direction. Its anterior wall looks directly downward and forward, making an angle of about 45 degrees with the horizontal palatine bodies. Seen from behind, the skull shows, above, the extent to which the crotaphyte fossæ approach each other in the median line and the crest that divides them from the occipital area. This latter has the usual form seen among these cormorant-like birds, constituting an arch over the foramen magnum, which occupies the center of a concavity below it. The supra-occipital prominence is here distinguished by a low, smooth median ridge, which traverses this dome-like elevation from the inter-crotaphyte line to the superior periphery of the foramen magnum.

The plane of this latter aperture is about perpendicular to the plane of the basis cranii. In outline the foramen is broadly elliptical, with the short axis transverse. At its lower margin we see a large ellipsoidal condyle, with its short axis at right angles with that of the foramen. Below this again are the oval openings in the basi-temporal, spoken of by Parker, with the prominent descending processes of this region flanking them on either side.

In form, the inferior *mandible* is spear-shaped, its sides tapering gradually to a sharpened apex. These latter, for the outer aspects of their anterior two thirds,

show the same character of venated surface as I described for the superior mandible. Posterior to this, however, as well as the inner ramal aspect, the bone is smooth, having the same appearance as in most birds.

The symphysis is short and develops a spine behind, which points directly backward and is in every respect similar to the process in the same place, between the sides of the lower jaw, in Herons and Albatrosses. Each ramus of this mandible is very thick from side to side, but these parts are hollow, and the bone as a whole, is very light, owing to the high state of pneumaticity it enjoys.

The principal foramina for the entrance of air to its interior are four in number, two on either limb, one being to the mesial side of the articular cup, and another larger, longitudinally piaced, elliptical one just beyond this concavity on the inner aspect of the ramus near its upper border. The superior side of an articular end has a deep excavation at its center upon which the facets for the quadrate do not encroach, so that, when the jaw is articulated, this pit comes opposite the notch between the trochleæ of the mandibular foot of the quadrate, creating an irregular hollow space there between the bones of no inconsiderable size. When the quadrate thus covers it there are two entrances that are left open, one in front and one behind, close to the pneumatic foramen.

The mandibular angles are truncate, very nearly perpendicularly so, their surfaces being concave and very broadly luniform in outline (Plate XXII., Fig. 7).

Commencing just in front of an articular cup, we find the superior border of the ramus to be rather wide and rounded as far as the meeting with the dentary This portion presents near its middle a double coronoid process, one being in front of the other. The dentary portion of their border has an outer cultrate edge and an inner and somewhat lower rounded one.

The outer edge goes to the anterior apex of the symphysis, the inner one to the hinder termination of the same, while between the two a nearly horizontal surface is contained, which gradually becomes narrower as we proceed in the forward direction.

The lower borders of the mandible are rounded for their entire extent, being produced beneath the articular cups and continuous with the inner boundary of either truncate angular extremity.

We find that the usual bones which surround the true ramal vacuity on the side of the mandible in many birds, here interlock with each other so as to completely fill the fenestra in, but in rather an unusual way, and apparently, for a definite purpose; for each ramus presents, both on its inner and outer side, an oblique slit, these slits being opposite each other and with their anterior ends in

the superior border. It is evident that this otherwise thick jaw is much weakened at these points in each ramus, and this occurs just posterior to the hinder termination of the horny sheath of the lower beak. In other words, the hinder moieties of the mandible are attached to the anterior or dentary portion by thin plates of bone, consisting principally of the splenial elements, and are capable of being bent outward, which, in the recent specimen can, owing to the way the quadrates are attached, be effected to a considerable degree. Now in life these oblique slits have their anterior ends come opposite the thin anterior insertions of the maxillaries, and these latter are just beneath the very mobile cranio-facial hinge, so that the whole apparatus is admirably arranged to permit an increase in size of the fore part of the buccal cavity when a Gannet swallows the fish that constitutes its food, and which its beak is so well fitted otherwise to capture. Moreover, this possible increase in caliber takes place in that portion of the digestive tract where it is most needed, or where the bony walls of the mouth would prevent the admission of a very large morsel, unless some such mechanism existed, — that is, at the very entrance of the buccal cavity, and just posterior to the more horny thecæ of the beak. In Gannets, however, this mobility is, to some extent, restricted by the integumental sheath of the beak.

Sulidæ have a wonderfully pneumatic skeleton, the entire structure enjoying that condition, save the ribs; all the caudal vertebræ (with the occasional exception of the anterior one); and, finally, none of the bones of the pelvic limb are pneumatic below the femur. The entire skeleton of the wing is perfectly so.

In a specimen of *Sula gossi* before me, *nine* or *ten* large *sclerotal plates* ossify in either eyeball, and these overlap each other much as we find they do in other birds. All the *tracheal rings* ossify quite perfectly, as do the *bronchial semirings* as they approach the lungs. These rings look like little, narrow, bony, double-overlapped straps, as they are arranged *in situ* to form the somewhat antero-posteriorly compressed windpipe. The usual bones of the *superior larynx* also ossify, and in the *syringeal portion* of the tube we find strong osseous arcades overarching the commencement of either bronchial tube, and parallel to them below, in the median line, the dividing *pessulus* is also in bone.

Anatomists have long known that the *hyoidean apparatus* as found in the *Sulidæ* is invariably a very much aborted affair. The only parts of it that ossify are, first, a little irregular piece which represents the *first basibranchial;* and second, articulating with this behind, are two simple curved rods of bone, which are the *cerato-branchials* of the thyro-hyals. Beyond these, no part of the tongue of a Gannet ever appears to ossify. It is hardly necessary to say that such parts of the skeleton

as the sclerotal plates, the tongue, or rings of the trachea, or much less certain sesamoids we will hereafter be called upon to describe, are ever pneumatic.

Of the Remainder of the Skeleton of the Trunk in the Sulidæ. (See Plate XXIII., Fig. 12.)

In the common Gannet there are twenty-one free vertebræ in the spinal column before we meet the one that first anchyloses to form, with the assistance of the fourteen succeeding ones, a sacrum for the pelvic bones. Then follow seven more free ones, devoted to the movable part of the tail. Finally, we have a long pygostyle that probably contains at least six more. Owing to the lengthening behind of its pelvic bones, the sacrum contains sixteen vertebræ in *Sula cyanops*, and that species has but six free caudal ones plus the pygostyle.

The sixteenth, seventeenth and eighteenth vertebræ support each a pair of free ribs; the next three belong to the dorsal series, and all have true vertebral ribs articulating with costal ribs from the sternum. This is also the case with the first three pairs that spring from the pelvic sacrum. The ribs on the sixteenth vertebra are exceedingly rudimentary, and the last pair of "floating" costal ribs have no corresponding pair of vertebral ones above them.

In mid-series these ribs support epipleural appendages, attached in the usual way to their posterior borders. (They may be anchylosed or free.) As I have already stated above, they are completely non-pneumatic.

The neural canal is notable for being nearly cylindrical throughout the first twenty-one vertebræ. It is only at the region of the enlargement for the brachial plexus that it is rather compressed in the vertical direction.

The atlas has a minute perforation in its cup, and its neural arch is strikingly broad and deep. The axis vertebra possesses a stumpy neural spine, and its hypapophysis, directed somewhat backward, is very prominent.

The odontoid peg is comparatively small and nearly sessile with the centrum, the latter presenting a concave face below it.

From the third to the fourteenth vertebra, inclusive, the neural spine is a very inconspicuous character, while from this on it gradually makes its appearance, increasing in size until we have the usual quadrate, longitudinal plate of the dorsal series.

The third and fourth vertebræ have each a prominent hypapophysis like the one on the axis, but in the fifth this feature nearly entirely disappears.

The sixth vertebra is faintly marked by the carotid canal; this gradually becomes more and more tubular in the seventh and eighth, while in the ninth to the thirteenth inclusive it is a closed cylindrical canal of a caliber somewhat less than the neural canal canal above it. It disappears entirely from the fourteenth vertebra.

The lateral canals extend from the third vertebra to the fifteenth, inclusive; they are short in any of the segments, and their posterior apertures are far larger than their anterior ones.

At the commencement of the cervical series the parial parapophyses are short and not particularly well developed. They project backward from the inferior walls of the lateral canals, but as the carotid canal begins to develop, these processes withdraw from the former positions, move gradually lower down beneath the centrum, and at the same time increase in length and importance, so that in those vertebræ where the carotid canal exists, they project from its postero-inferior border directly backward as parallel and not far separated spines.

The post-zygapophyses do not appear as divergent limbs until we find them so in the eighth vertebra; in all the cervical segments anterior to this one the facets are situated on the inferior aspect of the tuberous hinder end of the neural arch at its lateral angles.

Metapophyses are seen on the ninth vertebra, but gradually disappear, to be entirely absent in the fourteenth or fifteenth.

The transverse processes in the dorsal region are broad, flat, and horizontal, being directed more and more to the rear as we approach the pelvis. The plates of the neural spines above do not meet each other when the column is articulated, and there is an entire absence of all interlacing, ossified tendons or metapophyses in this region. In fact, all the vertebræ have a very clean-cut, non-angular appearance, with the majority of projecting borders rounded.

The articular ends of the centra are constructed upon the "heterocœlous" type; the anterior faces in the ultimate cervicals and leading dorsals being notably wide and shallow, and often riddled with foramina.

The pygostyle and the free caudal vertebræ will be spoken of after the pelvis has been described; in the meantime we will turn our attention for a few moments to the description of the sternum and pectoral arch.

The Sternum.—This bone in the Gannets has a very peculiar form. A pectoral aspect of the bone shows that the body has an oblong figure or outline, with the average width nearly equal to half the length. Beyond the true sternal body the anterior portion projects as a massive promontory, and a large part of the carina is beyond this again.

The anterior moiety of the bone is convex upon the dorsal side, and correspondingly concave on the ventral aspect. Behind, the body is so flattened out in *S. bassana* as to be nearly horizontal. The costal borders look outward and slightly upward, and each usually possesses six moderately well-developed facets for the costal

ribs. In a specimen of *S. bassana*, however (No. 18045 U. S. Nat. Mus.), and in one of *S. piscator* (No. 18739, U. S. Nat. Mus.), I find but *five* of these facets upon either costal border. There are no pneumatic foramina in the elongated and shallow intervals between them.

The principal orifices of this character consist in a diffuse group on the superior aspect of the anterior projecting part, within the general concavity of the bone.

Either costal process gracefully rises from its base as a laminated and prominent horn, curving in the anterior direction.

The posterior moieties of the lateral borders are somewhat rounded and extend almost directly backward over the lateral processes behind.

These postero-external xiphoidal processes are very long and wide, being rounded off at their extremities and directed a little outward. They are narrowest in *S. brewsteri*, more flaring in *S. gossi*, and very wide in *S. cyanops*.

They are created by this hinder portion of the bone being so profoundly one-notched that a general concave margin has resulted, with simply a median papilliform process remaining. Even this latter is frequently altogether absent in *S. gossi*, converting the posterior sternal border in this species into one long, well-marked concavity.

The carina juts out very prominently in front of the bone; its anterior angle is concave from above downward, and develops a large facet for the furcula, which in life articulates with it. Above this the border is again concave and sharp, while still above this there is a compressed process that represents the manubrium. This is the case in *S. bassana* only, for in the sternum of no other Gannet before us is there the slightest semblance of such a process as the manubrium.

The lower border of the keel is straight and in the horizontal plane, being capped off with a spreading rim. This border merges into the surface of the body of the bone before it half way reaches the xiphoidal notch.

The sides of the keel are smooth, and neither it nor the under side of the sternal body show in this specimen any of the muscular lines usually present in most birds.

A broad median notch, concave from side to side, convex from before backward, lies between the lofty superior portions of the coracoidal grooves. These latter meet in front of it, while behind, its surface becomes directly continuous with the general surface of the upper side of the body, and that where the group of pneumatic foramina are found.

A coracoidal groove looks forward and outward for its upper portion, directly upward for its lower, and extends rather less than half way between the base of the costal process and the median line. It consists of two portions which are directly

continuous with each other. The lower one is a shelf-like projection with a convex border forward and its articular surface in the horizontal plane. Immediately above this rises a much broader surface, though not so long, which is decidedly convex from above downward. This portion of the facet for the coracoid is considerably higher than the plane in which the borders of the body of the bone are found. It faces forward and outward, and has one regular convexity as its limiting margin above. Between the point of its outer termination and the apex of the corresponding costal process, the border is one sweeping concavity.

This form of sternum is more or less peculiar to the *Sulidæ,* and it departs in a number of points from the form of the sternum of the Cormorants and of the Pelicans. Comparatively, the bone is not so long in *Sula gossi* as it is in *S. bassana, S. brewsteri* and other species. Still the *general pattern* of the sternum is much the same throughout the *Sulidæ.* If we overlook the crossing of the coracoidal grooves in the sternum of *Phaëthon æthereus,* and its having a manubrium, there is a great deal in the bone to remind us of the sternum of *Sula gossi*—and, in fact, there are more steganopodous characters in the sternum of the Tropic Bird than there are of any other avian group with which I am at present acquainted.

Of the Shoulder-girdle.—(Plate XXIII., Fig. 12.) This part of the skeleton is, like so much of the rest of it, thoroughly pneumatic, the foramina occurring at their usual sites.

The clavicles form a broad U-shaped arch, being completely united below, where, at the median point beneath, they support an extensive facet for articulation with the carinal angle of the sternum. This does away with any such thing as a hypocleidium proper, notwithstanding the fact that the bone projects slightly over this facet.

The clavicular limbs are compressed from side to side, broader above than below, with their anterior and posterior borders rounded off.

A clavicular head is also compressed in the same manner as its shaft, and tapers off as a pointed process.

The most striking feature of this part of the bone is, however, the extraordinary facet it supports to articulate with the coracoid. Either one of these is situated at its outer side, upon a promontory of bone which is found there, the latter being of a proper form to receive it. The facet is of an elliptical outline, placed vertically, and facing directly backward. Something of a notch is found between it and the clavicular head, in which occurs a number of the principal pneumatic foramina of the furcula. On the anterior surface, just below the summit of a *coracoid,* we find a distinct elliptical facet for articulation with a similar one just described for the fourchette. Between this and the ear-shaped glenoid facet a considerable valley

is found. On the opposite side of the coracoidal head we find a group of pneumatic foramina, and below these a peculiarly formed scapular process, a spine-like apophysis, which rather gracefully curls upward and then toward the shaft of the bone. This latter portion of the bone is subcylindrical and smooth, dilating below into a transverse fan-shaped sternal extremity.

A *scapula* offers but a very small portion of the articular surface for the glenoid cavity ; not more than an eighth of it in all the specimens examined by me. The head of the bone then reaches forward and inward, but only the outer two thirds of this makes an indifferent articulation with the narrow and roughened border of the scapular process of the coracoid. The shaft of the bone is quite stout behind this and somewhat compressed in the vertical direction, while posteriorly it flattens out into a broad paddle-shaped extremity that finally tapers to a point behind.

Even more than it is in the case of the sternum, the bones of the shoulder-girdle in all the species of the *Sulidæ* at my hand are, apart from their specific variance in size, almost identically alike in each and every one of their corresponding characters. As for the bones of the shoulder-girdle in the *Phaëthonidæ*, we may say here, by way of comparison, that it is only in the scapula where we see the characters which more or less resemble the corresponding ones as we find them in the scapulæ of the *Sulidæ*. Neither the *os furcula* nor a coracoid of a gannet or booby bear any special resemblance to those bones as they exist in the tropic birds.

Of the Pelvis and Caudal Vertebræ.—The first vertebra that anchyloses with the pelvic sacrum anteriorly projects entirely beyond the iliac bones. Its centrum, in common with the next three that follow it, is much compressed from side to side, and its neural spine is continuous with the common neural ridge above the succeeding segments.

The first five vertebræ that lie beneath the ilia throw out their apophyses in the usual way for their support; the last two of this series meet the iliac margins. Here the neural canal and centra are large, in order to afford room for the increase in size of the cord where the sacral plexus is thrown off.

The twenty-eighth and twenty-ninth vertebræ have their processes thrown directly upward, so that they are scarcely visible upon direct ventral aspect.

In the thirtieth vertebra they are powerfully developed and extend directly across the basin to abut by anchylosis against the pelvic walls immediately behind the cotyloid cavity on either side. From this point the centra of the so-called urosacral vertebræ taper quite rapidly in size to the ultimate one, which, in *S. bassana*, is enlarged and exhibits a big facet on its posterior aspect, intended for the first free caudal. In *S. piscator* this enlargement is not evident.

The extremities of their diapophyses anchylose in a very thorough manner with the inner iliac margins, and a lateral view shows their sides to be riddled with pneumatic foramina between these processes.

Viewing this pelvis from above, we notice that the entire inner margins of the iliac bones have merged into and completely anchylosed with the sacrum. This converts the ilio-neural grooves into ilio-neural canals and gives the bone a very compact appearance. The anterior margins of the ilia are rounded, and are set off with rather a deep and raised emargination in *S. bassana*, which is feebly marked in *S. piscator* and other species.

The post- and pre-acetabular surfaces are about equal in the extent of their superficial areas, except in *Sula cyanops*, where the postacetabular area is the more extensive.

The anterior iliac surfaces are concave on either side, and each faces upward and outward to about an equal degree. *Sula piscator* here offers another exception, and in this species the pelvis is comparatively shorter, as well as broader and flatter than it is in other species of Gannets.

Elevated above these anterior iliac concavities we find the postacetabular area to be nearly horizontal. Large elliptical foramina are found between the apophyses of the last three or four uro-sacrals, and these latter, likewise, develop quite a prominent neural crest.

Upon the lateral aspect of this pelvis we find a very large cotyloid ring, the inner margin of which is fully equal in size to the outer. A moderately sized antitrochanter occupies its usual site, with its articular surface directed downward, forward and outward.

Behind this occurs an enormous elliptical ischiadic foramen, that occupies nearly all of this post-acetabular lateral aspect. Through the fenestra thus formed we are enabled to get a good lateral view of the uro-sacral vertebræ and the extensive pneumatic condition they enjoy.

The lower margin of the ilium is sharp and convex; it forms the superior boundary to a long, narrow, obturator space, which opens freely into the rather small obturator foramen.

A pro-pubis does not develop in the Gannets, while the post-pubis is, for the most of its extent, fragile and slender. It begins to increase in size just before arriving at a point opposite the end of the ischium. At this point it offers a small facet on its upper margin for the ischiadic postero-inferior angle, and the two bones are in contact here during life. The post-pubis, retaining its increase in size, then curves inward toward the fellow of the opposite side, to terminate in a cartilaginous tip.

The posterior border of this lateral aspect shows a well-marked ilio-ischiadic notch at about the middle of its extent. This character is best marked in *S. cyanops* and *S. gossi*, being much shallower in other species, especially in *S. piscator*. The outer side of the bone between it and the ischiadic foramen is directed upward as well as outward.

As has already been mentioned above, there are usually *seven* free vertebræ plus a large pygostyle in the skeleton of the tail of most Gannets and Boobies, but an exception is noted in the case of *Sula cyanops,* in which species I count in the specimen before me, only *six* and the pygostyle. The characters of these vertebræ may be well studied in the skeleton of the tail in *Sula brewsteri.* What first strikes one upon glancing at this part of the osseous system of any Gannet is its comparative massiveness, the great size of the individual vertebræ, and the large pygostyle. The neural spines however, are short and stumpy; in *Sula bassana* they are occasionally bifid anteriorly. The neural arches beneath them close over the spinal canal for the entire length of the series, and the latter, for a short distance, is seen to perforate the pygostyle. The transverse processes are thick and strong, being very wide-spreading, especially in the case of the ultimate and penultimate free ones. From four to five of the last ones usually develop hæmal spines. These become larger as we approach the pygostyle, the first vertebra of which also has one, it being bifid, and hooking forward, as do those on the caudals in front of it. The interarticular facet on the faces of the centra are nearly flat, showing barely any concavity or convexity.

The *pygostyle* appears to be composed of about six vertebræ, of which the three anterior ones can be quite easily made out. It has a very unusual form in this bird, being very long and subconical, with sharp superior border and rather decurved apex. Below, it is broad and somewhat convex. Viewing it from in front we notice that it has all the elements present, though in very rudimentary state, of one of the caudal vertebræ, including the large, prominent and anchylosed hæmal spine just mentioned.

The Appendicular Skeleton.

The Pectoral Limb. — We find the humerus in *Sula bassana* to be somewhat longer than the radius and ulna in this limb, but we shall see later on that this varies greatly in the other species. I will write out here first an account of the appendicular skeleton of *Sula bassana,* and close with the differences exemplified on the part of the other Gannets and Boobies we have under consideration. In this humerus the ulnar crest is prominent and projecting, though rather inclined to retreat from the elongated and shallow pneumatic fossa that arches over it, as in many other

water birds. The radial crest is reduced to a long, low, inconspicuous ridge, and, in fact, this proximal end of the humerus, as a whole, merges into the shaft so gradually from both sides, and its being so narrow withal, that we are rather impressed with its lack of strength and an absence of a certain robustness so characteristic of the bone in other birds of equal size and that lead a similar life. This in no way applies, however, to the shaft itself, for this subcylindrical and hollow, bony tube, with its double sigmoidal curve, carries with it the very elements of strength and power.

Its distal extremity lacks but little of being as wide as the widest part of the head of the bone. It is without an ecto-condyloid process, has the trochleæ very prominent, and presents for examination a deep fossa to the anconal side of the ulnar tubercle.

The shaft of *radius* for so long a one is unusually straight, and only a slight curve is noticed in the proximal moiety of the *ulna*.

In its continuity the former bone is subtrihedral in its form, with its pneumatic foramina situated beneath the transversely expanded portion of the distal end. Muscular lines mark this radial shaft along its inferior aspect.

For its distal moiety the shaft of ulna is nearly cylindrical in form, but this is gradually exchanged for the subtrihedral as we pass over the proximal half of the bone.

It presents for examination a double row of feebly marked papillæ for the quill-butts of the secondary feathers.

A long, shallow, though notable fossa is seen at the proximal and anconal side of the shaft, which terminates in a single pneumatic foramen just beyond the prominent cup-shaped articulation for the ulnar tubercle of the humerus.

Other pneumatic holes occur at the distal end of the ulna upon all sides, except the outer one. The olecranon, though large and rather tuberous, would not particularly attract our attention. A distinct canal upon the outer aspect of the distal end of the shaft for the passage of the tendons characterizes this bone. The articular surface shows nothing of special interest.

As usual, the carpal segments are but two in number — a *radiale* and an *ulnare.* They present the forms and facets common to these bones generally. Both are pneumatic and have large apertures for the admission of air to their hollow interiors.

The *carpo-metacarpus* also presents a number of those foramina at either of its extremities; the principal one, however, is found just below the trochlear surface formed by os magnum upon the anconal side of the bone. A notable process occurs immediately below it, as well as another group of these air-holes, in its outer aspect, near the short and inconspicuous first metacarpal.

The main shaft is straight and of good caliber; on the palmar side it is longitudi-

nally grooved nearly its entire length for a tendon going to the fingers. This is best marked upon the distal moiety of the bone. The metacarpal of the middle digit is also straight for the major extent of its course; its extremities becoming enlarged in order to allow it to make the usual connections with the metacarpal index. It is rather slender and develops no special processes, as it sometimes does in other representatives of the class.

The expanded portion of the proximal joint of the index digit is not perforated, not even by the numerous pneumatic foramina which are irregularly scattered over its surface. Below it is produced as a notable process, and a process that is seen in some of the extinct birds, as, for instance, in *Ichthyornis*. The shaft of this phalanx is broad and flat anteriorly, and perfectly straight from above downward.

Equal to half the length of the carpo-metacarpus, the distal phalanx of the index digit is of a trihedral form, with an extensive excavation at the posterior aspect of its proximal end, which is continued in a lesser degree the entire length of the bone. It bears no claw below, but is finished off by a distinct little process.

The pollex phalanx has very much the same form as the one just described, but it lacks the longitudinal excavation down its posterior aspect. Both of the bones are pneumatic. Lastly, we have the smallest phalanx of all, belonging to the middle finger. This, as usual, is behind the broad proximal joint of the index, and not quite equal to half its hinder border in length.

Now the general characters of the bones of the pectoral limb are, in *Sula cyanops*, *S. piscator*, *S. gossi* and *S. brewsteri*, in the main about the same as they have just briefly been given for *Sula bassana*. We find differences, to be sure, but they are very slight. The humerus in *S. cyanops* closely resembles that bone in *S. bassana*, only it is considerably smaller in the first-named species. Occasionally about the proximal end of the carpo-metacarpus the position and size of the pneumatic openings may vary, but that is often seen to be the case in all large birds with highly pneumatic skeletons.

In *S. piscator* the olecranon fossa of the humerus is comparatively larger and with better defined borders than it has in *S. bassana*. This is likewise the case in *Sula gossi* and *S. brewsteri*, in both of which species that fossa is especially well marked. Beyond such trivial departures as these, we meet with little or nothing worthy of formal record. Individual specimens of the same species, however, vary a little; take, for example, the carpo-metacarpus. It is seen to be rather smaller than that of another specimen of the same species of *S. bassana* now at my hand for comparison.

Where remarkable differences do come in, is in the relative *lengths* of these bones when we come to compare them in one species with the corresponding bone in another. In speaking of *Sula bassana*, I said above that its humerus was *longer* than the radius or ulna; now this is not the case in other species of Gannets, as the subjoined table will plainly show.

MEASUREMENTS IN CENTIMETERS AND FRACTIONS.

Species.	Humerus.	Ulna.	Carpo-metacarpus.	Joints of Index Digit.
Sula bassana.	23.5	20.4	9.6	9.6
Sula cyanops.	19.3	20.7	8.8	8.1
Sula piscator.	17.1	18.4	7.2	6.9
Sula gossi.	16.2	17.3	7.6	6.9
Sula brewsteri.	18.4	19.8	8.1	7.6

Of the Pelvic Limb.—In comparison with the general size of *Sula bassana* the lower extremity is very short, though the bones composing its skeleton are none the less strong in consequence. In the *femur* we find the axis of the head and neck making an angle with the longitudinal axis of the shaft. The head is quite distinct, globular, and, as usual, excavated on top. Its surface is continual with the broad articular surface which occupies the entire summit of the bone. No trochanterian ridge rises above this latter, and, indeed, this character of the femur is but poorly developed.

A pneumatic foramen is always seen at its most common site, on the anterior aspect, just below the superior articular surface.

The shaft is cylindrical, roughened in some places by lines and diffuse tuberosities for muscular attachment, and is bent slightly to the front and somewhat to the inner side. At its distal extremity the condyles are fashioned after the usual pattern among birds, but all their characters in *Sula* present a sort of lack of strong development. The fibular cleft is but faintly marked, the intercondyloid notch or fossa is shallow, and the ridges in front much rounded and inconspicuous.

Something of the same condition is extended to the proximal end of the *tibiotarsus* of the leg, though not to such a marked degree. Here the cnemial process rises but slightly above the articular summit of the bone, and the pro- and ecto-cnemial ridges which descend below it soon merge into the shaft, and are, at the best not very prominently developed.

The shaft of this bone is straight and smooth and somewhat compressed throughout from before backward. It offers a long ridge to the fibula and is broad across where it is found. The distal extremity of the bone evinces more character than

the proximal one. An oblique bridge, to confine the extensor tendons, is extended across the deep groove that contains them during life. Nearly parallel with each other, the condyles are wide apart, prominent and convex in front, to become suppressed and low and thin-crested behind.

The fibula has the usual form seen in birds, but is here particularly interesting from the fact that it does not anchylose with the shaft of the leg-bone until it arrives at the middle of its lower third, and even from this low point the remainder of the bone, including an oval "external malleolus," stands out quite prominently. This rare condition of things has been pointed out also by me as occurring in *Urinator lumme.*

Sula bassana has a long oval *patella,* obliquely marked across its anterior surface by a groove for the tendon of the ambiens muscle.

The *tarso-metatarsus* in *Sula* is strikingly large in its proportions when compared with the other bones of the limb. In length it is a little more than half as long as the tibiotarsus, but being wider and broader it appears much more massive. Its hypo-tarsus presents three short, longitudinal elevations of unequal sizes. These inclose two tubular passages for tendons, and are grooved themselves besides. In other specimens they are flat, and the two outer elevations may posteriorly meet, thus creating a vertical perforation rather than a groove. The back of the shaft is flat, but in front it is much scooped out above, where it shows two antero-posterior perforations.

At the distal extremity three large trochlear projections present themselves. They are separated from one another by wide clefts of about an equal depth. These trochleæ are placed nearly side by side, the middle one being the lowest down, the inner next, and the outer one the most elevated. Their median grooves are best marked behind, but in addition the internal trochlea presents a deep, vertical notch upon its outer aspect.

The usual arterial perforation pierces the bone above the cleft found between the outer and middle projections, a groove leading into it from above.

The accessory metatarsal is rather an elongated bone, swung in the usual way by ligaments to the lower part of the shaft.

The basal joint of the hallux, which it supports, is comparatively more slender for its length than the other joints of the foot.

For the three anterior toes these latter are, in number and arrangement, the same as in the vast majority of the class. They present all the characters usually attributed to the phalanges of the podal digits in birds, and are well proportioned, both as regards their relative calibers and lengths.

The pneumatic foramen in the femur of *S. cyanops* is usually very large, and comparatively small in my specimen of *S. piscator*. This also applies to *S. brewsteri*, but in *Sula gossi* it is notably very large again. The general characters of the femur are much alike in all typical Gannets.

The tibio-tarsus and fibula in *Sula cyanops* agree with those bones in *S. bassana*, as they practically do in other species. There is a difference seen in the degree of distinctness of the distal end of the fibula. The entire bone can easily be made out in all my specimens of *S. gossi*, and only, or less than, the distal fourth of it fuses with the tibio-tarsus in that species. The tibio-tarsal condyles are far apart in *S. piscator* and *S. gossi*, and in most birds of this family this character is more evident than it is in *S. bassana*. In this last-named species the tibio-tarsus and tarso-metatarsus are all non-pneumatic; I fail to find any pneumatic openings in the tibio-tarsus of *S. cyanops*, but the tarso-metatarsus of that species enjoys that condition to a very high degree, as numerous and large air-holes are found about the head of the bone. Another remarkable fact is that the tarso-metatarsus in *Sula cyanops* is rather larger than that bone in *Sula bassana*. It is very small in *S. piscator*, and in all considerable variation may exist in the hypotarsus, for the places where the tendons pass through may be either grooves or perforations. Whatever they are, however, they never exceed two in number. Below I give a table showing the comparative lengths of these bones in the species under consideration.

Measurements in Centimeters and Fractions.

Species.	Femur.	Tibia.	Tarso-metatarsus.	Middle Anterior Toe.
Sula bassana.	7.4	10.9	6.1	
Sula cyanops.	6.4	9.9	6.5	
Sula piscator.	4.9	6.9	3.8	
Sula gossi.	5.4	7.9	4.9	7.9
Sula brewsteri.	5.9	9.1	5.7	8.3

From this study it is hardly necessary to add that the skeleton of the pectoral and pelvic limbs of the *Sulidæ* is entirely different from the corresponding parts and bones in the *Phaëthonidæ*.

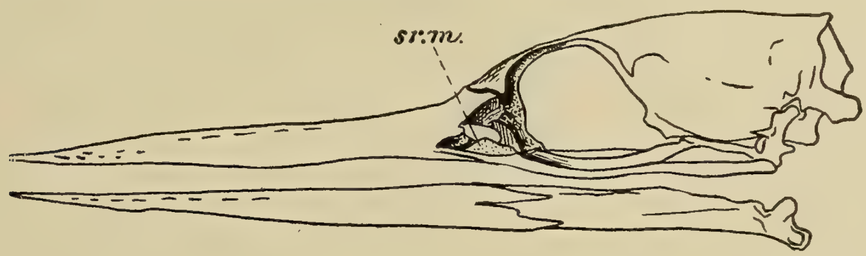
Anhingidæ.

Osteology of Anhinga anhinga.

As will be seen by my list of material given above, I have, at the present writing, but a single skeleton of this family of birds, before me for examination. It is complete, however, and there are at hand the accounts of the osteology of *Plotus* by other authors. Doctor R. Bowdler Sharpe in his recent *Hand List of Birds*

(1899) retains all the Anhingas in the family *Plotidæ,* and, in addition to two fossil forms, recognizes our existing species, viz: *P. rufus, P. melanogaster, P. novæ-hollandiæ,* and *P. anhinga.* The *Anhinga anhinga* is the sole representative of this family in the United States. A peculiarity of the skeleton of *Anhinga* is, it is almost completely non-pneumatic. It is only into the base of the cranium and the articular ends of the mandible that air gains access through minute foramina occupying the usual sites.

Of the Skull.—This bird has a very perfect "cranio-facial hinge," and measuring each way from the center of it we find the superior mandible to be about 1.5 cm. longer than the cranium. In form the superior mandible is long, narrow and spear-shaped, being drawn out to a sharp point. It is nearly straight. Beneath, it is flat with cultrate tomia. The culmen is rounded off, and the nasals have so fused with the surrounding bones of the face that most of the sutural lines cannot be distinguished in the adult. Where the external nostrils would naturally occur, there are usually present only minute holes that do not appear to reach in so far as the rhinal chamber. Viewed from above, we are to observe that the cranial and frontal



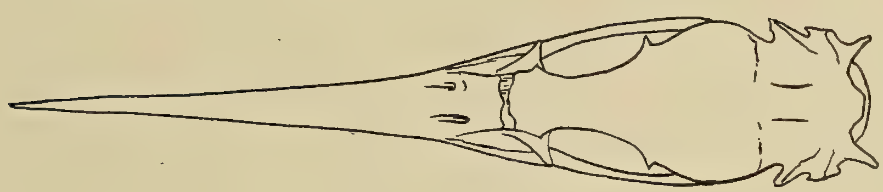


FIG. 3. Left lateral view of the skull, including mandible, of a specimen of *Anhinga anhinga.* Natural size, in outline, by the author from specimen 18259 of the Coll. U. S. Nat. Museum. *sr.m,* the supramaxillary bone.

FIG. 4. The same skull, seen from above. Mandible removed.

region are somewhat narrow and elongated; the former being smooth and moderately rounded, the latter flat and measuring about half a centimeter between the sharp edges of the superior peripheries of the orbits. For its hinder half, longitudinally, this part of the skull presents a low, median prominence, created by the approach upon either side, of the extensive, though shallow, crotaphyte fossa. We

may also see, upon this aspect, the conspicuous *exoccipital processes.* They project almost directly backwards, and only slightly outwards. Posteriorly, the superior occipital area is seen to be bounded above by a sharp and raised line, much curved, which distinctly separates the occipital from the parietal region of the skull. The foramen magnum is very large, and subcircular in outline, its mid-vertical diameter being scarcely shorter than its transverse one. The unnotched condyle is of good size, hemispherical in form, and sessile.

Seen upon lateral aspect, we are struck with the open, shallow auditory fossa, which is overhung by a raised squamosal ridge, the squamosal process being small. Anterior to this region the lateral wall of the brain case is extensive, smooth and convex, otherwise presenting no special characters. The orbits are large, being continuously circular in front and above, the curve extending from the very short postfrontal process to the lower end of the lacrymal bone. No osseous septum divides these cavities, and a large, median, heart-shaped foramen occupies the central part of the anterior wall of the brain-cavity, from which, during life, the olfactory nerves pass out. Below this another median opening exists, of no inconsiderable size. It is the anterior common aperture of the optic nerves, and it is flanked upon either side by a vertical, scale-like flake of bone, extending forwards. The parial grooves for the first pair of nerves faintly mark the orbital roof above; each one leads to a corresponding foramen found over either *pars plana* in front. A pars plana or ethmoidal wing is oblong in form, and taken in connection with the lacrymal, makes a very complete osseous partition standing between the eye-socket and rhinal cavity. The mesethmoid is small, and is carried forward for a short distance as a thin median plate of bone, with a free anterior, thin edge. In the forepart of the nasal cavity there are two small foramina, in the otherwise solid wall, which lead forward into the cancellous tissue filling in the upper osseous beak. They are placed side by side. A *lacrymal* is a peculiarly twisted bone, articulating above with the frontal and nasal. It has an external transverse antero-posterior deep groove above, below which the bone becomes, as it were, twisted and expanded, into a broad quadrilateral plate. This stands transversely and forms, with the corresponding pars plana, the anterior orbital wall. The lacrymal reaches down to the zygoma and is a free bone. In front it has, articulating with its antero-lower angle, a scale-like piece, that stands vertically and rests for its entire length upon the upper surface of the maxillary. This is the *supra-maxillary.* (Fig. 3 *sr.m.*) Each zygoma is twisted and much flattened. Anteriorly, their broader surfaces lie in the horizontal plane, while the posterior moieties are in the vertical one. The peg-like, articulatory nibs at their hinder ends for the quadrates are very small. Looking at the skull from a direct

inferior view, many of the points already described can be distinctly seen. This is due to the peculiar flattened conformation of the cranium. Indeed, the form of the brain-case indicates that *Anhinga* has an elongated, vertically compressed brain, but relatively not as much so as it is in a Cormorant, where it is also wider. The basitemporal area is small and triangular, with moderately prominent paroccipital processes, each one descending from one of its postero-external angles. The anterior apex of the basitemporals is run out as a scale-like point, which underlaps the meeting of the thoroughly open *Eustachian grooves.* The usual foramina for the facial, glossopharyngeal, vagus and hypoglossal nerves, and the internal carotid arteries are plainly seen in this region. They are quite distinct from each other, and, as a rule, nearly circular in outline. The rostrum of the sphenoid is a very delicate, rod-like bone that is extended backwards in the median line under the cranium as far as the eustachian entrance, as a sharpened osseous ridge. In front it fuses with the mesethmoid. For their posterior moieties, the *palatines* are thoroughly coössified in the middle line, where they send down a faint crest from the sutural juncture. As thus constituted the common bone lies in the horizontal plane, with postero-external angles but faintly indicated, but with a short process extending directly backwards from either side of the united facets for the pterygoids. Anteriorly, the palatines are much narrower, where they are also in the horizontal plane, and mesially separated by an elongated opening that leads above into the rhinal chamber. Their distal ends run forward to fuse with the nasals, maxillaries, and premaxillaries.

The *maxillo-palatines* are very wide apart, and each one is simply a subvertical, thin, plate-like scale of bone for the most part free behind, but fusing with the usual bones in front. A shallow, medio-longitudinal groove marks the united palatines behind, and this is occupied by the slender, presphenoidal rod. A *quadrate* has a small, spine-like orbital process; a compressed mastoidal head of no great size, which is barely divided into two facets; a large, antero-posteriorly disposed facet for the mandible which is separated by a pronounced cleft from a much smaller one, the entire outer side of which is occupied by the pit for the end of the zygoma. The bone I believe to be pneumatic.

The *pterygoids* are flake-like, flattened bones with very sharp edges, and with very distinct ends bearing the articular facettes for the bones with which they articulate. Each pterygoid has a length of a little more than a centimeter. A circlet of small "sclerotal plates" are found in either eye, and the hyoidean apparatus is but feebly developed. I have not examined the ossicles of the ear. Conforming to the shape of the cranium and superior mandible, we find the lower jaw assumes the form

of a long and narrow V. The ramal sides are not deep; there is no ramal vacuity; and the bone gradually tapers to a sharp point in front. From the nature of the splenio-dentary articulation—the thin bones being feebly wedged together there—the mandible is of a consequence very weak at that point. A considerable symphysis exists, with the barest rudiment of a median, inter-ramal spine present. For the most part, the upper and lower borders of the bone are rounded, though the supero-dentary edges, from sphenial articulation to apex are inclined to be cultrate. Either coronoid process is very much reduced, while between it and the articular cup for the quadrate, on the mesial aspect of the ramus, is a long foramen of an ellipsoidal outline, entering the inner structure of the jaw. Each hinder end of the mandible is, as usual, constructed to articulate with a corresponding quadrate. On the upper side of one there is a deep, rather narrow, obliquely-placed cup—its mesial end being the anterior one. This is for the *inner* articular facet of the foot of the quadrate. In front of this is a small, nearly flat, articular surface, and it is for the *outer* facet of the quadratal foot. Facing directly forward, and standing on the postero-internal edge of the cup is still another small facet, intended for a corresponding one on the same bone. These articular cups develop no inturned mesial processes, but the usual pneumatic foramen is present. The articular processes standing out behind, are of good size, of a quadrilateral form, and so twisted that the lateral surface in either case looks slightly upward and, to a much greater degree, outward.

Of the Axial Skeleton.—Endowed as it is with special points of interest, much has been written upon this part of the anatomy of *Anhinga.* It has been touched upon with greater or less elaboration by Brandt (Mem. de l'Acad. Imp. Sci. de St. Pétersbourg, tom. v., 6^{ime} Série, Sect. de Sc. Nat., 1839), by Mivart, in his memoir in the T. Z. S., already cited, by Garrod (Coll. Sci. Mem., p. 334), by Donitz (Archiv für Anat. u. Phys., 1873, p. 357), and by Hunter (Essays and Obser., 1861, v. 11, p. 328), and by others. Most of these writers have been attracted by the peculiarities seen in the spinal column, which I will now proceed to examine.

In the *atlas* we find the articular cup of the condyle perforated near its upper border. Its neural arch is nearly as deep as it is wide, and from it projects behind, upon either side, a conspicuous little spine. The small hyapophysis of this vertebra also projects posteriorly beyond the centrum. From the *axis* to the seventh inclusive, the vertebræ are especially notable for being of no great caliber in point of size, and at the same time remarkably elongated. A low, sharp neural ridge and hyapophysial spine characterize the axis. Its postzygapophysial part is welded into a common plate of bone, with the articular facets upon its under side. Upon its ventro-posterior aspect an open channel is formed by a curling downwards of bone

from the centrum upon either side. This traverses the entire length of the vertebral body in the third, fourth, fifth, sixth, and seventh vertebræ, but becomes less and less marked. On the eighth it is strong again, running between the enormously long parapophysial processes. In the ninth it is the subvertebral arterial channel, and is arched over with bone anteriorly. This remains to be the case to the thirteenth inclusive, while in the fourteenth the channel disappears behind, though the covered arterial passage still persists on the antero-ventral aspect, beneath the centrum. Both are absent in the fifteenth vertebra. Parial parapophysial spines first appear in the *axis*, where their distal apices fuse with the bone posteriorly. These spines, though present, are by no means a prominent character in the third to the seventh vertebra inclusive. Suddenly in the eighth they become remarkably developed, and are nearly as long as the bone itself. In the ninth they at once commence to shorten again, and this rapidly continues to be the case, until they, after somewhat changing their character, have entirely disappeared in the seventeenth vertebra. A most remarkable series of "lateral canals" exist in these vertebræ. I note them first in the axis, where they are of capillary dimensions and run nearly the entire length of that elongated bone. Anteriorly, either one opens at the base of the odontoid process, the posterior opening being on the side of the vertebra near the postzygapophysial base. In the *third vertebra* these canals are almost imperceptibly increased in caliber, and open upon either side, anteriorly, in a *slit* which is seen to exist between the prezygapophysial facet and the very much vertically compressed facet of the centrum. Behind, it opens a couple of millimeters in front of the articular surface of the centrum. But little change takes place in this particular in the fourth to the seventh vertebra inclusive, except that in the fifth, sixth and seventh a minute foraminal opening pierces the canal on either side about the middle of the bone on its ventral aspect. In the eighth vertebra the caliber of the lateral canals is about doubled and their posterior openings are moved far forwards so as to be found on the side of the vertebra, above the base of the enormously elongated parapophysial process; and between two fringe-like, long, ossified tendons that are attached to and especially characterize this bone of the vertebral chain. With their anterior openings remaining practically the same as described above, and the hinder ones just posterior to the parapophyses, no change is noted in the ninth except an increase in point of the size of the tube on either side. This increase goes on gradually to include the eighteenth vertebra, in which bone these lateral canals last appear. In the seventeenth they are very short, truly lateral, and somewhat compressed from above downwards; markedly most compressed in the eighteenth.

The *neural spine,* feebly developed in the third vertebra, becomes a prominent character of the fourth, where it occupies the posterior moiety of the bone, as a conspicuous blade-like crest, with rounded superior margin. In the fifth, sixth, and seventh this character disappears; in the eighth it is feebly present; in the ninth it is a roughened tubercle, entirely vanishing again in the tenth to the fifteenth inclusive. In the remainder of the series, back as far as the pelvis, it is large and of an oblong form, with thickened superior border. Throughout the dorsal vertebræ, ossified tendons of great length are coössified with this spine, projecting backward in the leading dorsals, and both backward and forward in the ultimate ones.

A low, sharp, hæmal spine occurs on the *ninth* vertebra; it being at the anterior part of the bone, on the parapophysial bridge that closes in the passage for the carotids. It is still better developed on the tenth; where sharp lateral ridges begin to show, one upon either side of it. All these processes are very pronounced in the thirteenth and fourteenth, while in the fifteenth their entire character is changed. In it the lateral ridges almost entirely disappear, and an enormous, quadrate hæmal spine is thrown down from nearly the entire length of the centrum. In the sixteenth it is not quite so large, and its hinder angle is produced backwards. A remarkable change is seen in the seventeenth vertebra, where the ventral aspect of the centrum is very much broadened, quite flat, and the little hook-like, laterally-compressed hæmal spine occupies a mid-position on the posterior border. In the eighteenth, ninteenth and twentieth the process is practically absent, and the great breadth of the centrum gradually narrows again, as its lateral margins are deflected. This form sees its extreme in the twenty-first vertebra, where the centrum is markedly compressed from side to side, and the aforesaid lateral margins are, ventrally, converted into a double hæmal spine.

In the twenty-second and twenty-third the spine is single, and the transverse compression of the centra is most apparent, being present in a marked degree.

Anapophysial ridges are more or less conspicuously developed in the ninth to the fourteenth vertebræ, inclusive, and in the dorsal series proper, are long and broad, and, as said above, are provided with fringe-like metapophyses frequently of considerable length.

In the first eight cervicals, the anterior articular facets are placed *laterally* upon either side of the neural canal, and their surfaces face forwards and towards the median plane. In the ninth vertebra these facets are, as it were, rotated backwards, so as to be *above* the neural canal, and face towards the median plane, and very slightly dorsad.

So in the articulation of the eighth vertebra with the ninth, a decided angle is made—nearly a right angle—with its salient point to the front. This also occurs between the ninth and the tenth and so on down the chain, becoming, however, less and less marked, disappearing entirely after the fifteenth, after which the vertebræ articulate in a straight line. The extremities of the long parapophysial processes of the eighth vertebræ articulate in the shallow grooves on the forepart of the ninth vertebra, on its ventral aspect.

Garrod has said that "Donitz figures a pair of accessory bony bridges on the dorsal surface of the vertebra following the most lengthy one, which must evidently, therefore, be the ninth. He, however, speaks of it as the eighth, which seems to me to be an error depending on the omission of the consideration of the atlas, because in *Plotus anhinga* (both from Brandt's figure and my specimens) it is most certainly the ninth, as it is in *Plotus novæ-hollandiæ*, *Phalacrocorax carbo*, and *P. lugubris.* I have, however, not seen *Plotus levaillantii.*"

"Donitz attributed the peculiar kink of the neck of the Darters, which it is impossible to obliterate without lacerating the surrounding muscles, to the presence of the bony bridges he describes; in this, however, he is mistaken, it depending on the above-mentioned peculiarity in the eighth cervical vertebra, by which it is angularly articulated with the seventh and ninth vertebræ, the upper genu being posterior, and the lower anterior. In further verification of this, it may be stated that in *P. anhinga* the bony bridges do not exist, and yet the kinking is most strongly marked." (Coll. Scientif. Mem., pp. 336, 337.) The bridges here spoken of are also absent in my specimen of *A. anhinga.*

The neural tube is not very large in the first eight cervicals, where it has more or less a cylindrical form posteriorly, but becomes somewhat antero-posteriorly compressed as we gradually pass towards the fore end of the vertebra. Increasing again in size after the ninth, it seems to attain its greatest capacity in the sixteenth, seventeenth and eighteenth, to become small and cylindrical once more as it passes through the dorsal series. In the ninth and tenth vertebræ the anterior opening of the neural canal lies in a plane which is about perpendicular, in each case, to the plane in which the posterior opening is found. That is, upon direct dorsal view of either of these two vertebræ, the posterior opening of the neural canal is not in sight, while we look almost directly into the anterior opening.

On the sixteenth vertebra we find the first pair of cervical ribs; they are long and slender and without uniform processes. We find also a large pair of free ribs on the seventeenth cervical vertebra, which commonly have unciform appendages. These are anchylosed to the bone, and are large and broad. Next to these two pairs

of cervical ribs, we meet with three pairs of true dorsal ones, they all having large costal processes, and all joining with the sternum by means of their hæmapophyses. There are two pairs of pelvic ribs, the first having stunted costal processes, though its hæmapophyses join with the sternum. In the last pair the unciform appendages are always entirely absent, and the costal ribs do not reach the sternum. Briefly then, there are *seven* pairs of ribs in this Darter, and this I believe to be generally the arrangement in all typical Cormorants.

Several of the authorities I have referred to above have both described and figured the *pelvis* of an *Anhinga*, and the bone possesses a number of interesting characters. *Fifteen* vertebræ of the spinal column fuse together to form its "sacrum." The leading *six* of these throw out their transverse processes to coössify with the ventral surfaces of the anterior portions of the ilia. The centra of the first *three* are markedly compressed transversely, the first one being very deep, the next less so, still less so the last. A large hæmal spine is also found on the first, which becomes rudimentary on the one behind, to be entirely absent in the one next in order. Two or three vertebræ throw out their processes to abut, upon either side, against the ilia at points just posterior to the cotyloid rings. Posterior to these, the outer extremities of the processes of the vertebræ completely fuse with the inner borders of the ilia; while on either side, from the acetabulæ all the way to the tail, occurs a row of interapophysial foramina, a feature so characteristic of the pelves of the Cormorants. The last vertebra, though not free, is to some extent individualized, and the extremities of its transverse processes may not so completely ossify with the ilium on either hand, which latter bones are here drawn out into peculiarly elongated posterior processes. Viewed upon its dorsal aspect we are to note that the anterior portions of the ilia are much horizontally expanded, while the narrowest part of the pelvis is just in front of the acetabulæ, where either iliac border shows a marked concavity. Thorough fusion of the internal iliac borders and the "sacral crista" takes place, and not even do the usual "neural canals" or "grooves" remain open posteriorly. This is well shown in *Plotus levaillanti* (Pl. XXI., Fig. 1). In front the iliac borders develop a raised emargination, and a strong brush of coössified tendons always project directly forward from the diapophyses and neural spine of the leading vertebra of the "sacrum." Passing to the post-acetabular portion we find that the pelvis is broader than it is in some of the Cormorants, and we are particularly struck with the prominent crests formed by the union of the internal iliac borders and the sacrum. The neural arch and the common neural spine of the latter is also conspicuously raised in this part of the pelvis. This begins moderately about opposite the cotyloid rings, and increases as we advance towards the tail.

This elevation of the center and margins causes the formation of longitudinal depressions between them, and down the center of either one of these we find the row of interapophysial foramina, to which reference has already been made above.

Some Cormorants seem to have a fairly well marked *propubic spine*, and there is an indication of the rudiment of such a process in the *Anhinga*. The internal circumference of either cotyloid ring is smaller than the external, and these cavities are brought up very close to the sacrum. Of enormous dimensions is the ischiadic foramen; it has the effect of absorbing nearly all the ilium above, and to some extent behind it; while below, it makes the neck of the ischium very narrow indeed. In form this large foramen is subelliptical. The "obturator foramen" opens into the obturator space, which latter is also extensive, and the pubic style which bounds it below as far as the point where it meets the ischium, is very slender and frail. Beyond this, the pubic bone is in close contact with the lower margin of the ischium, where it is very considerably stouter, as it also is after it becomes suddenly deflected behind after passing the extreme distal angle of the ischium—precisely as as it does in typical Cormorants.

A deep, triangular ilio-ischiadic notch, between the here very narrow ilium and the far broader ischium, indents the posterior pelvic border.

The antitrochanters are prominent, and the facet on either one of them looks forwards, downwards and slightly outwards.

Ventrally, the "pelvic basin" is seen to be fairly capacious; the "sacrum" is considerably enlarged opposite the acetabulæ and beyond; the exits for the nerves of the sacral plexus are double; finally, in front, we see the horizontally spreading ilia, with the compressed vertebræ, dipping down anteriorly so far ventrad.

There are *six* free caudal vertebræ in the skeleton of the tail of this Darter, plus a large pygostyle. This latter bone is drawn out supero-posteriorly, and the long superior edge is very sharp. Its antero-inferior angle is enlarged, with flattened surface below. Beyond this, the inferior border gradually contracts and becomes rounded. In front there is an extensive pit for articulation with the last caudal vertebra, and above this there is a small opening where the spinal cord enters this bone.

The centra and their articulatory facets are large in these vertebræ, but the spinal canal is of no great caliber. In mid-series the neural arch and spine, and the forward-projecting prezygapophyses are conspicuous. A good-sized hæmal spine also characterizes the last four vertebræ, and in each case it extends forwards to underlap the bone next in advance. As a rule the transverse processes are rather short and stumpy, being entirely rudimentary in the sixth caudal.

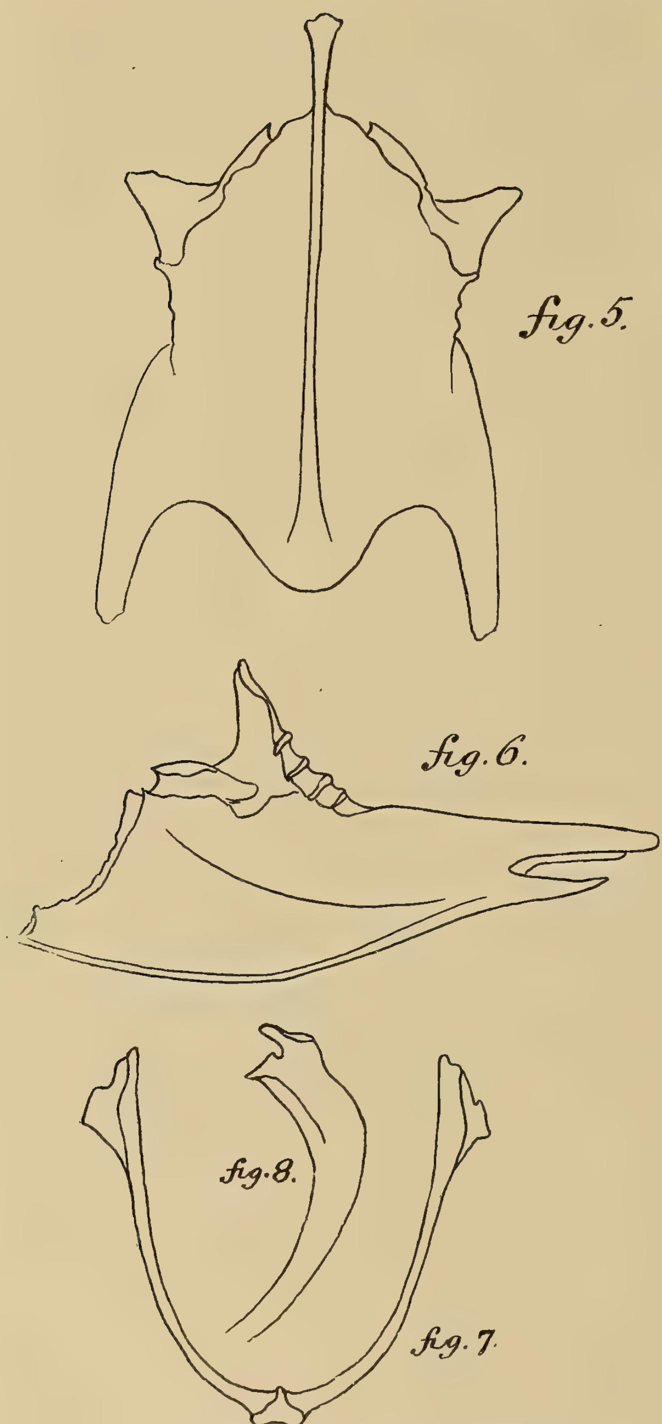


FIG. 5. Ventral aspect of the sternum of *Anhinga anhinga*.
FIG. 6. Left lateral view of the same bone shown in Fig. 5.
FIG. 7. Anterior aspect of the *os furcula* of *Anhinga anhinga*.
FIG. 8. Mesial side of the scapular end of the same bone shown in Fig. 7. All the cuts are natural size from the specimen (No. 18259, Colls. U. S. Nat. Mus.). Outline drawings by the author.

The Sternum and Shoulder Girdle.—Many of the characters of the sternum of a Darter essentially agree with the corresponding ones as they occur in the sternum of such Cormorants as represent the genus *Phalacrocorax*. Its carina dies out on the under surface of the body before arriving at the mid-xiphoidal process behind; and is deep only in front, where it protrudes forwards, with a sharp anterior border, and bears a large facet, occupying the carinal angle, for articulation with the os furcula. Only the merest rudiment of a manubrium is to be seen at the usual site; possibly the process is entirely absent in some specimens. A wide concave notch separates the coracoidal grooves mesiad, and the large, elongated coracoidal facets above them. Large, acutely triangular costal processes are developed, each one projecting outwards at an angle of about 45°, and very slight forwards. The costal borders are short and much contracted; either one supports four transverse hæmapophysial facets. Posterior to the costal borders the sternum widens, and its lateral margins are sharp. Its hinder border is also sharp. Two large, broadly concave notches exist

here. They give rise to long, lateral xiphoidal processes, and a shorter mid-xiphoidal process. On its thoracic aspect the sternal body as a whole is well concaved—uniformly so, as the position of the heel beneath is but barely indicated down the median line. The form and proportions of the sternum in *Anhinga* are well shown in my figures 5 and 6.

The *os furcula* is of the typical U-shaped pattern, with large, expanded clavicular heads. There is but the barest rudiment of a hypocleidium below, while a facet is present on the nether side of it, for articulation with the carinal angle of the keel of the sternum. Either broad, laterally-compressed clavicular head, is bent rather abruptly downwards; a projecting, facet-bearing shoulder is developed for the coracoidal articulation. Above either of these facets we note a strong process pointing backwards, which, when the os furcula is articulated *in situ*, rests upon the summit of the corresponding coracoid. (See Figs. 7 and 8.)

Both Darters and Cormorants have unusually long *coracoids*. In *Anhinga* the coracoid is longer than the femur. Its sternal end is considerably expanded, and shows a wide and rather deep excavation on its posterior aspect for the coracoidal groove and facet upon the sternum, while anteriorly the corresponding surface is narrow and shallow. A costal process is not developed, but that border is convexly rounded and sharp. The shaft of this bone is antero-posteriorly much compressed, and in front a strong, muscular line marks it longitudinally, especially near the sternal end. The scapular process is much aborted, but the head is quite massive and tuberous. Its entire antero-mesial aspect is occupied by an oval facet for articulation with the clavicular head of the furcula. The scapular facet is small, but the glenoid surface is of fair size.

Quite uniform in width and moderately pointed distally, the thickish blade of a *scapula* has its posterior extremity but very slightly bent outwards. The anterior end of this bone is wide transversely, and the long acromial process decidedly tilted up. The glenoidal process also stands out rather prominently, while the articular facet for the coracoid is comparatively small. Just posterior and beyond the glenoidal facet, the border of the scapula is broadly rounded, but is sharp all along its mesial edge, clear to the tip of the acromial process. It is only the distal third of the bone that is vertically compressed and at all blade-like.

On the Appendicular Skeleton.

Being thoroughly non-pneumatic, the long bones of the limbs in *Anhinga* are solid and heavy. Although not so very far from being double the size, the humerus of *Fregata* weighs about the same as the humerus of the species of Darter we are now

describing. In *Phalacrocorax urile* the ulna is somewhat longer than the humerus, while in this Darter the humerus is considerably longer than the ulna. These are interesting facts.

In *Anhinga anhinga* the *humerus* has a length of about 13 centimeters, and it presents the usual double sigmoid curve. This latter, however, is far better seen upon a superior view of the bone, rather than upon its anconal aspect. (See Fig. 9.)

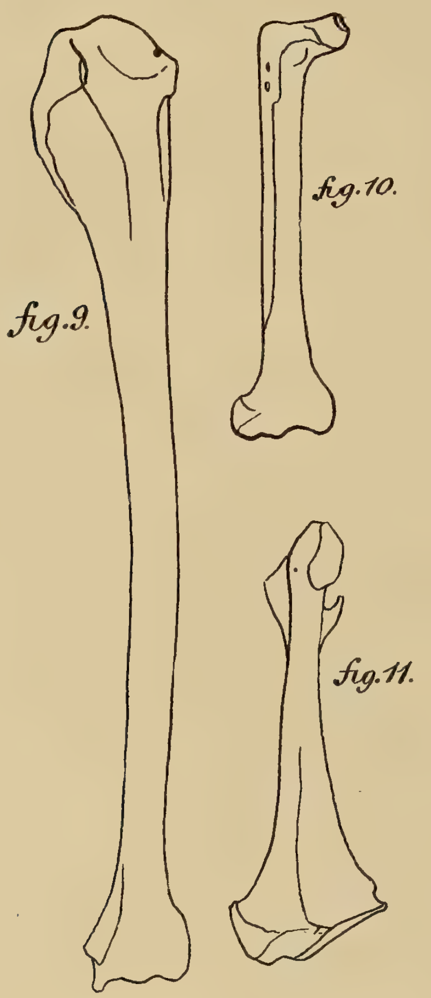


FIG. 9. Anconal aspect of right humerus of *Anhinga anhinga*. FIG. 10. Anterior view of right femur of *A. anhinga*. FIG. 11. Right coracoid of *A. anhinga*. Seen from in front. All drawn in outline, natural size, by the author, from Spec. No. 18259, Coll. of U. S. Nat. Museum.

The proximal end of the bone is narrow and elongated, merging with the shaft very gradually. The radial crest is a low, long ridge of uniform height; while the ulnar crest and tuberosity are prominent and are bent anconad. This creates a deep valley between the true articular humeral head and the ulnar protuberance. The excavation over which the latter arches, and where the pneumatic openings usually occur in other birds, is very shallow, and indeed so very much so that really no fossa may be said to exist there at all. A marked diffuse excavation exists upon the palmar aspect of this part of the humerus; this is spread out over a regular area just within the distal half of the radial crest, but joins with a far narrower and somewhat deeper strip that bounds the humeral head distad, and lies on the opposite side of the bone to the ulnar crest. All this excavation is powerfully marked in *Phalacrocorax*.

The humeral shaft proper is subcylindrical in form, being of nearly uniform caliber for the middle third of the bone. At the distal extremity all the most usual ornithic characters are prominent and pronounced. The olecranon fossa is shallow, but the ulnar and radial tubercles jut out very conspicuously, though not as markedly so in proportion as in the Cormorants.

The *ulna* has a length of about 11.5 cm. and is moderately bowed from one end to the other. The points of attachments for the quill-butts of the secondary feathers present quite a striking feature, and each seems

to consist in a small pitlet, with its upper and lower edges very slightly raised, but in a manner hardly to suggest the idea of a "papilla" or "tubercle" as I have so frequently described them for many other kinds of birds.

The ulna develops a distinct lip of bone, that curves partly round the head of the *radius* when they are articulated *in situ*. This latter bone, hardly half the caliber of the ulna, shows barely any bowing or curving at all throughout its continuity. Distally it is deeply grooved on top for the passage of tendons, while a deep circular cup for articulation with the radial tubercle on the humerus surmounts its head or proximal extremity.

The two usual ossicles, *radiale* and *ulnare*, compose the skeleton of the wrist in the adult.

The *carpo-metacarpus* has a total length of 6.5 cm. and is characterized principally by a deep pit on the palmar size of the head, between the pollex metacarpal and the process for muscular attachment. This is also a very general phalacrocoracine character. The shafts of index and medius metacarpals are very straight, and the latter about as long as the former, has not more than about one fourth its bulk, and is compressed throughout, the flat surface of the opposed side being presented to the shaft of the former. The pollex metacarpal is short, and, on the whole the bone is not very unlike what we find it to be in the Cormorants.

No perforation exists in the dorsal expansion of the proximal phalanx of the index digit, and none of the terminal joints of either the thumb or the other two fingers have claws at their extremities. The one belonging to the medius is comparatively long, and very sharply pointed.

I am not familiar with the existence of any special sesamoids about the articulations in the skeleton of the anterior extremity, at places where they exist in some Auks and other water birds.

Passing to the PELVIC LIMB we find a *femur* with a length of 5.5 cm.; a tibiotarsus with a length of 9 cm.; a tarso-metatarsus of 4 cm.; an accessory metatarsus of 1.4 cm., which is nearly equalled by the patella — it having a length of 1.2 cm. In the foot, the skeleton of hallux measures 3.1 cm., the inside toe 4.7 cm., middle toe 7.5 cm., and outside toe 8 cm.— the ungual joints being included in each case.

Proportionately the femur is longer in *Anhinga* than it is in *P. urile*, and is not bowed so much in the antero-posterior direction. The summit of the bone is capped off with the articular surface, above which neither the caput femoris nor the trochanterian crest, rises. The external condyle is more prominent and lower on the bone than the internal one, and is deeply cleft for articulation with the head of the fibula.

Neither the "rotular channel," nor the popliteal fossa are very deeply excavated; and on the head of the bone the pitlet for the ligamentum teres is also quite shallow. The muscular lines of the shaft are distinctly defined both in front and behind.

With its shaft somewhat antero-posteriorly compressed, and very slightly bowed to the front, the *tibio-tarsus* presents us with pro- and ectocnemial processes well developed, and a cnemial crest that rises above the summit of the bone. Of considerable length is the conspicuous ridge for articulation with the fibula, and at the antero-distal extremity of the shaft we observe the presence of the osseous bridge under which the tendons pass in life. This end of the bone inclines as it were to the inner side, so that if the mid-vertical axis of the large internal condyle were extended it would be removed from and parallel to, the longitudinal axis of the shaft, rather than being in the same line with it.

Both extremities of this bone, as is the case with the extremities of the tarso-metatarsus, are more or less massive and enlarged as compared with the shafts of the same. Coming to the *fibula,* it is very interesting from the fact that it is *complete,* rather more so if anything than we find it to be in either *Pandion* or *Urinator,* and is only anchylosed to the tibio-tarsus by means of its enlarged and extreme distal end. This limited fusion of the two bones takes place at a point just above the external condyle.

Anhinga has a large *patella,* but proportionately not as large as we find it in the Cormorants. It is an oblong sesamoid, nearly equilateral, concave behind and convex anteriorly, where it is transversely perforated by a minute foramen for the passage of the *ambiens muscle.*

As will be seen from measurements above, the *tarso-metatarsus* is relatively a short bone of the leg; it is further characterized by having its somewhat broad shaft compressed in the antero-posterior direction and marked longitudinally upon both aspects by strong muscular and tendinal lines and grooves. The hypotarsus is strongly developed, especially the interno-lateral part of it, which, by a plate-like extension, has a firm attachment to the upper third of the shaft. Its posterior angle above is always thickened and doubly pierced for tendons. The externo-lateral part of the hypotarsus is small and it also creates by its form a groove and a foramen for certain tendons that pass through or over them during the life of the individual.

One or two small foramina pierce the upper part of the shaft in an antero-posterior direction, the most constant one making its exit behind to the inner side of and at the base of the hypotarsus. At the distal end the trochleæ for the toes stand well apart. The inner one of the three is the lowest, and juts out in a prominent way from the bone, and has a tubercle projecting from its lateral aspect.

The mid-trochlea is massive, not quite centrally located on the end of the shaft, and is the next lowest in point of position. The highest of all is the external one, and its outer part is produced the farther behind.

On the anterior part of the shaft in front, in the groove extending up from between the mid- and external trochleæ, occur *two* perforating foramina. The lower one makes its exit in the intertrochlear notch; the other on the shaft above it. Nearly all existing birds have only a *single* foramen at this point. It is even single in *Phalacrocorax.*

The free first metatarsal is large and strong, twisted upon itself, and with an elongated transverse facet for articulation with the hallux. The skeleton of the *pes* is remarkably well developed. The phalangeal joints, arranged upon the plan of 2, 3, 4, 5 for hallux to outer toe inclusive, are stout and strong, and the terminal ungual joints are, one and all, handsomely curved and sharply pointed at their extremities.

We now pass to the consideration of the osteology of the Cormorants, which it will be found agrees in many particulars with the species of Darter we have just been describing.

Observations on tha Skeletology of the Phalacrocoracidæ.[10]

A great many Cormorants of the world's avifauna, as I have before stated, belong in this family, and as far as at present known it is the only one represented in the United States, where, as heretofore noted, the nearly a dozen species and subspecies it contains have all been restricted to the single genus *Phalacrocorax.* Cormorants are a good deal alike in their osteology, and in this part of their anatomy, too, they have a good deal in common with the Darters. To give the salient features of the skeleton in this group I will draw upon the skeleton of *P. urile* in particular, as well as in general those of the collections of the U. S. National Museum, and also republish a short description, together with the figures illustrating it, of *P. per-*

[10] In his recent (1899) *Hand-List of Birds,* Dr. R. Bowdler Sharpe presents also a classification of the Cormorants (pp. 232–235). They constitute the first group of his Order (XXIII.) Pelecaniformes, and all are relegated to the family *Phalacrocoracidæ,* and this latter is divided into four (4) genera, viz: (1) *Phalacrocorax;* (2) *Pallasicarbo;* (3) *Nannopterum,* and (4) *Actiornis.* The first of these contains forty-two (42) species of existing cormorants, and ten (10) extinct forms; the second is represented by a single extinct type, the *P. perspicillatus;* the third contains only the singular cormorant of Narborough and the Galapagos Islands; while finally, the fourth genus is also represented by a single extinct form, the *A. anglicus* of Lydekker. In the United States we have some six (6) species and five subspecies of Cormorants, all of the family *Phalacrocoracidæ.* Through the constant energy and perseverance of Mr. Lucas, a large proportion of these Cormorants are represented in the collections of the U. S. National Museum by their skeletons, and through his kindness I have been enabled to study and compare all this material in the revision of the present memoir. The collection in question is now doubtless the finest of the kind in the world, and has in it the skeletons of more steganopodous birds than that of any other in existence.

spicillatus, Pallas's Cormorant, given by Mr. F. A. Lucas in the Proceedings of that institution for 1889 (pp. 88–94), also other material and figures by the same author.

When we regard the skull of *P. urile* from above, we observe that the cranium is very flat, and, across the parietal region, broad. Indeed, though large, the brain-

Fig. 12. Left lateral view of the skull of *Phalacrocorax urile*; nat. size. By the author, from a specimen in the Smithsonian Institution. *st.o.*, the occipital style. (See also Plate XXIV., Fig. 15.)

cavity is vertically compressed, and this is one of the first things to attract our attention as we examine the skull of this Cormorant. Between the sharp superior edges of the orbits the frontal region measures transversely about a centimeter, and this too is the average width of the not very mobile cranio-facial hinge. A broadish, shallow, longitudinal groove traverses the fronto-parietal region, and the well-marked crotaphyte fossæ fail quite to meet on top of the prominent, convex occipital elevation. The occipital line and crest are very sharp and ridge-like, and a free, *osseous, occipital style,* over a centimeter and a half long, articulates at a median point a short distance above the large foramen magnum, where these lines and crests meet. This style is distally pointed, has sharp supero-median and lateral borders, which give rise to supero-lateral surfaces intended for the attachment, on either side, of the posterior part of the temporal muscle. (See Fig. 12.)

The upper bony beak is somewhat broad at its base; is slightly longer than the cranium; narrow for its anterior half; edges semi-cultrate; very moderately decurved at the end; culmen broadly convex from side to side; flat beneath; external narial apertures absent. A groove passes down upon either side, which is deepest at those sites where nostrils occur in most birds that have them. There is a minute foramen on either side, communicating with the rhinal chamber. The lateral processes of the cranium are almost entirely aborted, and the orbital cavity behind freely opens into the cranio-zygomatic space, and the cranial wall here is bulging, smooth, and convex. At the occiput the usual processes are fairly well developed, and the quadrato-mandibular articulation, on either side, is located far posteriorly as in an alligator.

In their essential characters, the quadrates, the pterygoids, the palatines, and the maxillo-palatines agree with what we found above in *Anhinga*. *Phalacrocorax* also has a small *supramaxillary*, or as Parker called it, a "post-maxillary," and according to him it is large in *P. carbo*, and small in *P. graculus*.

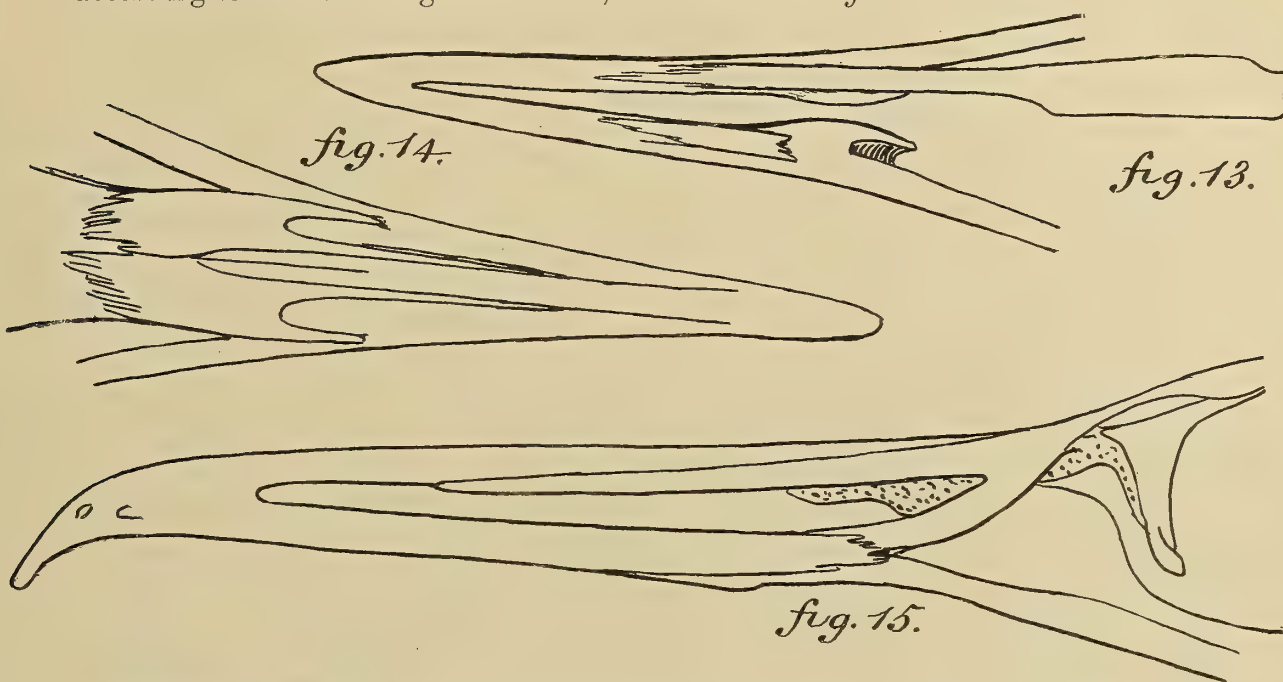


FIG. 13. Palatal region of a young *Phalacrocorax urile*, showing the maxillo-palatine of the right side.

FIG. 14. Dorsal aspect of anterior part of the cranium of a young *Phalacrocorax urile*, showing the absence of a fronto-nasal hinge.

FIG. 15. Lateral aspect of beak of a young *Phalacrocorax urile*, showing the open condition of the nostril. All three figures drawn by Mr. F. A. Lucas from specimen No. 12732 of the collections of the U. S. Nat. Museum, and enlarged by means of the camera lucida.

Regarding the *maxillo-palatines* and related bones in the skull of a Cormorant, it seems that ornithotomists do not quite agree as to the exact sutural boundaries, and it seems that Mr. W. P. Pycraft, of the British Museum, some time ago printed an article on the osteology of certain steganopodes, in which he was at variance with anatomists upon this point. Desiring the opinion of Mr. Lucas upon this point, he has kindly furnished me with the following remarks, and illustrated them with some drawings, which latter are here reproduced as Figs. 13, 14 and 15. In his communication he says: "Some difference of opinion exists as to just what portions of the maxillaries represent the maxillo-palatines, and while I do not like to differ with my friend Mr. Pycraft for fear I be on the wrong side, yet, after carefully considering the subject, the conclusion is forced upon one that the posterior extensions of the maxillaries are the maxillo-palatines."

"By the kindness of Mr. R. C. McGregor and Mr. Curtis Clay Young the Museum some time ago came into the possession of an extremely good series of Cormorant skulls of all ages, and by means of these it is possible to trace the process of ossification very well. These seem to show that the desmognathism of the Cormorant's skull is caused by the growth of bone between the maxillaries, and is not due to any outgrowth of those bones themselves."

"This ossification commences between the backward processes here considered as the maxillo-palatines and progresses until they are firmly united. The union of the anterior portion of the maxillaries occurs later and is due to the extension of ossification into the tough lining of the roof of the mouth; and there is frequently a small space between the maxillaries which remains open for a long time if not permanently" (Fig. 13).

"The formation of the fronto-nasal hinge (Fig. 14) is a secondary character, the bones so overlapping in young birds that there is no freedom of movement in this region."

"The absence of external narial openings is also a secondary character, for the young Cormorant possesses perfectly open nostrils while the cranium is almost as schizo-rhinal as that of a gull (Fig. 15). As growth proceeds the narial openings become more and more restricted, until about the time (the exact time is uncertain) that the young birds take to the water, not only the external openings, but those of the cranium have become completely filled."

Passing once more to the skull in the adult we find the interorbital septum is unossified, as is the greater part of the anterior wall of the brain cavity. However, we here find the "foramen rotundum" separated from the far larger vacuity above, by a transverse bony bar. A subcircular vacuity also occurs in the mesethmoidal plate; and the sphenoidal rostrum is not as large as the zygoma.

Phalacrocorax urile differs from the *Anhinga* inasmuch as in it the *pars plana* does not ossify; and in the form of its lacrymal bone. One of these in this Cormorant is seen to be fused with the frontal bone and nasal above; is *laterally* composed; *not* in contact with the maxillary below, where it sends outwards a short process, and inwards a longer and slenderer one, the mesial end of which fuses with the mesethmoid (see Fig. 12).

This specimen (No. 18982, Coll. U. S. Nat. Mus.) lacks a *vomer*, and it was not to be found in my skeleton of *Anhinga;* in the latter, if it ever existed, it may have been lost—but I see in another place, where remarking upon the osteology of *P. bicristatus* (now *urile*) (*Science*, N. Y., v. 11, No. 41, Nov. 16, 1883, p. 640), I have said that in it "we observe a long attenuated vomer, terminating anteriorly in a free

pointed extremity." But I am inclined to think that the vomerine ossification is not always a constant character in these birds. Ossifications of the eyes, ears and tongue agree in the main with the corresponding parts in the *Anhingidæ*, and have been more or less fully described above.

V-shaped in pattern, the *mandible* is a strong bone in birds of this family. This is due to the thickness of the rami, and not to their height, for they are rather low than otherwise; also to the unusual firmness of the dentary ossification with the other bones posterior to it, and finally to the total absence of a ramal vacuity—the mandible not being weakened at those points (see Plate XXIV., Fig. 17). Each dentary upon its mesial aspect shows a deep longitudinal groove. The articular ends are truncated posteriorly, though the postero-mesial angles are somewhat produced. Each of these articular cups appears to be connected with its respective ramus by a kind of neck, which is directed backwards and towards the median line. When seen from above, and the jaw is articulated *in situ*, this gives rise to rather an odd-appearing articulation. Either quadrate is thus entirely shut out of sight, with the exception of its externo-lateral process, the base of which does not come in contact with the mandible at all. The sides of the rami are *within* the quadrato-jugal bars, and rise somewhat above them. The pterygoids, owing to a special notch in each articular cup, are thoroughly exposed, but no more.

Of the Remainder of the Axial Skeleton.—Seventeen vertebræ are found in the cervical region of *P. urile*, before we arrive at one that bears a free pair of ribs. A small pair of rudimentary ones in this species are to be observed in the eighteenth vertebra. Now in *P. urile* these last are not liberated, while in the nineteenth and twentieth vertebræ the free ribs are long, well developed, and have anchylosed upon them large unciform processes. In the leading pair, however, either upon one side or the other, this last character may be absent. Such is the case on the left side of the specimen at my hand.

P. urile has its entire vertebral chain in many respects quite different from anything we described for *Anhinga*. We do not meet with the greatly elongated eight leading cervicals, and the abrupt change in character as we pass to the ninth one. Nothing of the kind occurs in the Cormorant, for in it the eight leading cervicals are quite in harmonic proportions in all respects with those that follow them. We nevertheless find in this Cormorant the same modifications, only in a far less marked degree, in the eighth, ninth and tenth vertebræ, which give this bird the power to draw back its head and with great rapidity to thrust it forward again, the point of flexure being between the vertebræ just mentioned. Anhingas catch all the fish they eat by spearing them with their sharp beaks while in active pursuit *under*

water. The head is drawn back and then thrust forward like a spear, with wonderful rapidity and precision—the prey being transfixed on the closed, lance-like mandibles. When prepared to deliver the blow, the angle formed by the seventh and vertebræ points backwards, and the one between the eighth and ninth forwards, the eighth vertebra itself standing subvertically between them. Gannets and Herons have the same arrangement of these cervical vertebræ, but nothing like as well developed as we find it in the Darters. Bitterns show it well,[11] as do all our American Herons, and they *transfix* their prey, although they do not pursue it under water as the Darters habitually do.

P. urile has handsomely developed parapophysial spines on its cervical vertebræ. They are rudimentary on the atlas and axis, coming to be of good size on the third vertebra. From it on they gradually increase in length, but diminish in caliber, until we come to the tenth cervical. In it they are as straight as sewing needles, and as long as the centrum of the vertebra. They die out on the fifteenth cervical. The lateral canals are normally developed and of good size in the third vertebra at its anterior part. They very gradually increase in size down the series, until we arrive at the first vertebra bearing free ribs. On the other hand the hypapophysial carotid canal begins in the fourteenth vertebra, and terminates in the seventh; it never quite closes in so as to form a perfect tube, but comes very near it in the thirteenth vertebra. A large hæmal spine suddenly appears on the fifteenth cervical, and the character persists down the series, to include the leading two or three vertebræ of the pelvic sacrum. Hæmal spines are also found on the atlas and axis; and a strong neural spine first appears on the sixteenth vertebra, while on the eighteenth to the twenty-third inclusive they are very large, strong, oblong in form, and much in contact with each other in the dorsal region of the spine; the various articulations among the vertebræ are very close indeed. Here the centra are much compressed from side to side; the transverse processes narrow and spreading, and these latter have strong metapophysial spines interlocking at their extremities. But there is none of that luxuriant interlacing of ossified tendons that we see there, and on the neural spines and anterior iliac margins, as in *Anhinga*. *Phalacrocorax* is more or less free from that.

There are *three* pairs of large, strong dorsal *ribs*, bearing great, flat, anchylosed unciform appendages. By a graduated series of costal ribs, these vertebral ribs join with the sternum. The first pair of pelvic ribs likewise, by a very long pair of hæmapophyses, connect with the sternum. Small unciform processes also appear upon them, but not on the last pair of pelvic ribs that follow these. Nor do the

[11] See the author's reference to this in the American Bittern in *The Auk*, Vol. X., No. 1, January, 1893, pp. 77–78.

costal ribs of this pair quite reach the sternum. On the left side in the specimen before me there is also a "floating costal rib," with a length of nearly 3 centimeters. It lies close along the posterior border of the distal moiety of the ultimate hæmapophysis.

This last-mentioned bone in a specimen of *P. urile* articulates with the sternum on the left side, and no doubt from time to time such will be found to be the case in other species of *Phalacrocorax, i. e.*—the ultimate pair of costal ribs or hæmapophyses, upon one side or the other, or for the matter of that, upon both sides, may join with the sternum the pelvic ribs to which they belong.

In *Phalacrocorax* we find a *pelvis* very much like the one we described for *Anhinga*. The ilia are horizontally spread out in front, where they may be so thin as to present a number of perforating foramina. In the postacetabular region these bones come much closer together, both actually and relatively, than they do in the Darters. The interdiapophysial foramina also are present, a row upon either side of the *posterior sacral crista*, and they are very large just before we arrive at the first caudal vertebra. The internal iliac borders are not elevated here as they are in *Anhinga*. Cormorants of this genus also have the large obturator space; the enormous ischiadic foramen; the rudimentary propubis; and the same peculiarities of the postpubis.

Posteriorly, either ilium sends back a conspicuous process, and the two hold firmly between them the first free caudal vertebra. In some species, as *P. urile*, they may grasp two instead of one. An ilio-ischiadic *notch* is also present upon either side of the pelvis.

There seem to be *seventeen* vertebræ included in the pelvic sacrum to the *fifteen* we found in *Anhinga*. Six of these are beneath the fore part of the ilia; two more with aborted processes lie immediately between the large acetabulæ ; two true dorsal ones follow these, and they have their lateral processes thrown out as abutments to the walls of the pelvis; finally seven more so-called uro-sacrals are to be counted between these and the first caudal.

Viewed ventralwise, the pelvic basin is seen to be deep and capacious. Another marked character on this aspect is the strong ridge or crest of bone on either side, which extends longitudinally backwards from a point below the cotyloid ring to the hindermost angle of the ischium. It is strongest directly below the great ischiadic foramen. This character is but feebly marked in the pelves of the Darters.

There are six caudal vertebræ and a *pygostyle*. The latter is large; pointed posteriorly, triangular in form, broad and flattened at its lower part behind, in front of which there is a hæmal spine. Hæmal spines are also found upon the last three caudals, and neural ones on them all. These tail vertebræ are large and strong,

and the transverse processes on the fourth and fifth extend out considerably beyond the others of the series.

Sternum and Shoulder Girdle.—In the article in *Science* cited above it was said of the sternum of *P. urile* that it had "two shallow excavations on either side of the median line, occupying the entire xiphoidal margin or border" (p. 641). This no doubt was a *lapsus calami,* as no true Cormorant has more than one such excavation upon either side of the sternal keel. Apart from its greater size, the sternum in *P. urile* agrees in almost every particular with that bone as we described it for *A. anhinga.* The lateral xiphoidal processes, however, are comparatively not as long nor as narrow; nor are the costal processes of the sternum of the Cormorant relatively as lofty or as slender as they are in the Darter. Otherwise the two bones essentially

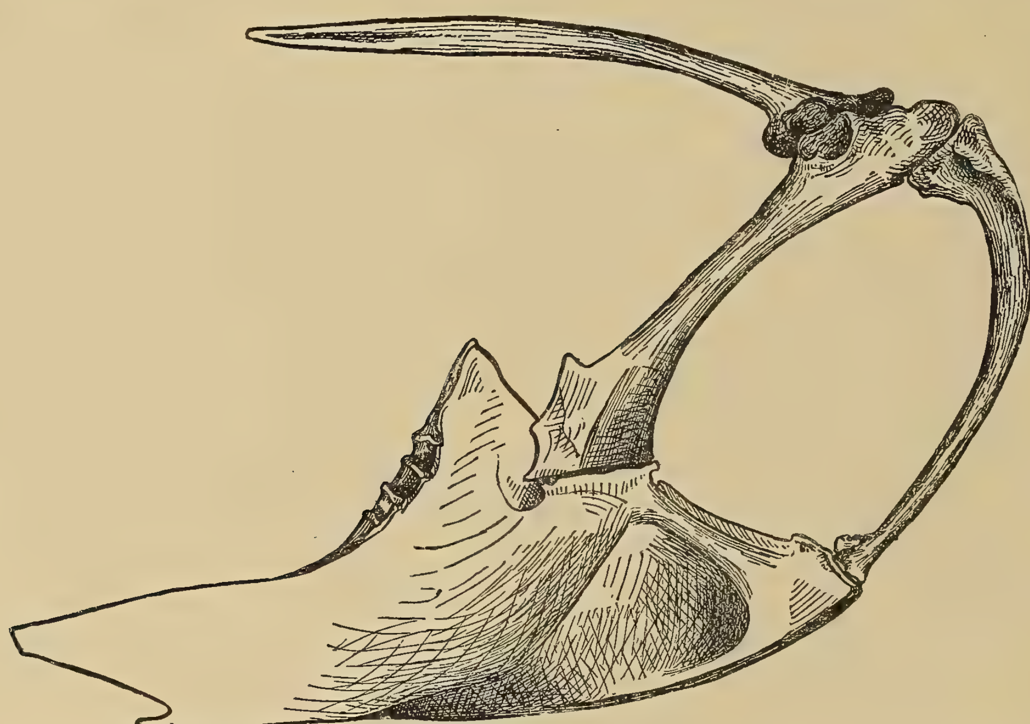


FIG. 16. Right lateral view of sternum and bones of the shoulder-girdle of a Cormorant (*Phalacrocorax urile*), nat. size, by the author, from a specimen in the collection of the U. S. Nat. Museum. (Compare this figure with Fig. 30 of Plate XXVI.)

agree. (Compare also the sternum of *Phalacrocorax albiventris,* Pl. XXVI., Fig. 30.) Again upon comparing the several bones of the *pectoral arch* in these two forms, we are once more at a loss to find any noteworthy differential characters. The *os furcula* in each are upon identically the same pattern; the *coracoids* are alike with the exceptions that in the Cormorant the bone is proportionately not as long; its sternal end

is more expanded, and it has a broadly developed "costal process." In the case with the *scapula*, we find that the blade of it in the Cormorant is not as much curved, nor is the distal end of the bone at all bent outwards. (See Fig. 16.)

On the Appendicular Skeleton of P. urile.

Very little of the skeleton of this Cormorant is pneumatic. For the most part the bones are solid and heavy. Apparently air gains access only to certain parts of the cranium and lower jaw, other bones of the osseous system being completely non-pneumatic. This is especially true of the skeleton of the limbs, where all the bones typify in the highest degree the unaërated variety.

In a number of respects the bones of the *pectoral limb* of *P. urile* present characters which essentially agree with those upon the corresponding bones as found in the arm of an *Anhinga*, which characters have already been described above. In the *humerus* of *Phalacrocorax*, however, which is shorter than the ulna, the "pneumatic fossa" is profoundly concave, quite as much so as in those large species of birds in which the bone is pneumatic, or even more so than in some which show that condition. At its distal end the articular protuberance for the radius has an elongation at its proximal extremity which is bent over towards the mid-longitudinal axis of the shaft of the bone. The "oblique tubercle" for the ulna is more hemispherical than we usually find it in birds. At the proximal end of the *ulna* we observe a conspicuous projecting lip of bone, which contributes an additional surface for the radial articulation. Papillæ down the shaft of this bone for the quill-butts of the secondary feathers are in a single row and rather feebly developed. Both *radius* and ulna are somewhat bowed, and when articulated *in situ* they are in contact for their distal moieties while proximally a good-sized spindle-shaped interosseous space occurs between them.

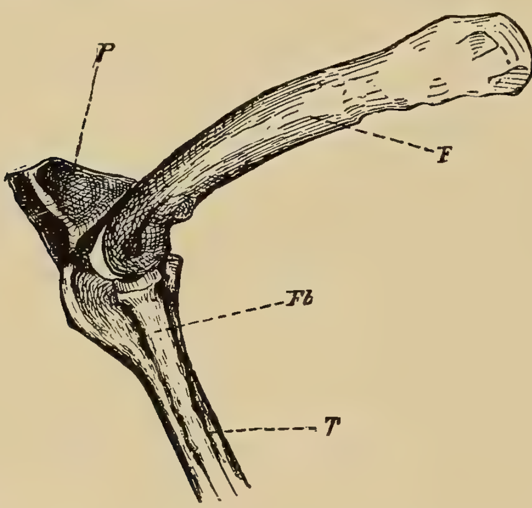
The characters of the skeleton of the hand are practically the same as we found them to exist in the manus of *Anhinga*. There are no distinguishing characters of any importance.

Gannets have the skeleton of their pectoral limbs in many respects like the Cormorants and Darters, but in them all the bones are completely pneumatic. When we come to consider the difference in the habits of the representatives of the three families, this is not so much to be wondered at.

Cormorants are more or less like the Darters too, in the osteology of their *pelvic limb*. There are more differences, however, to be found here than we discovered upon comparison of the pectoral extremities. *Phalacrocorax* has the *femur* proportionately stouter, shorter, and more bowed in the antero-posterior direction than it is in *Anhinga*.

We also note that the pit for the insertion of the *ligamentum teres* is more elaborately scooped out, and the trochanterian protuberance is produced far more to the front in the Cormorant, such hardly being the case at all in the Darter. The fibular and intercondyloid notches are very deeply sculpt, though anteriorly the rotular channel is unusually shallow.

The large trihedral *patella*, with its broad, flattish base is, as Garrod remarks, often laterally pierced for the passage of the tendons of the ambiens muscle.[12] The



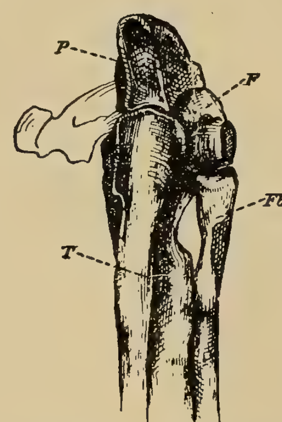


FIG. 17. Knee-joint of a Cormorant (*Phalacrocorax urile*); natural size. *F*, femur; *P*, patella (originally described by the author in *Science*); *Fb*, fibula; *T*, tibio-tarsus. Drawn by the author from a specimen in the Smithsonian Institution.

FIG. 18. Knee-joint of *Phalacrocorax urile*, seen from in front. Natural size. Letters signify the same as in other illustrations.

cnemial processes of the tibio-tarsus are fairly well developed and are confined to the anterior aspect of the head of the bone, where we also see a strong cnemial crest rising above its summit. For its entire length, the shaft is compressed in the antero-posterior direction, and the fibular ridge is long—standing well away from the side of the shaft. *Phalacrocorax* has the *fibula* about as well developed as we found it in *Anhinga*, it being *complete* and fused with the tibio-tarsus only at its distal end. When the bone is held vertically the internal tibio-tarsal condyle is the lower of the two on the extremity of the shaft.

Cormorants have a *tarso-metatarsus* differing in some marked particulars from that borne in the Darters. In the first place it is pierced by but one arterial foramen at its trochlear end, and its mid-trochlear process is the lowest on the shaft, rather than the inner one as in the Anhingas. Tendinal grooves, and their dividing lines up

[12] Garrod, A. H. Coll. Scientif. Mem., p. 198.

and down the shaft, back and front, also slightly differ, as does the form of the hypotarsus in a lesser degree.

The skeletal plan of the *pes* in *Phalacrocorax* essentially agrees with what we found in the *Anhingidæ*. We are to note the great length of the basal joint of hallux, and for its entire continuity, how much the shaft of the bone is bowed.

Mr. Frederic A. Lucas, Curator of the Department of Comparative Anatomy in the U. S. National Museum, in describing some of the bones of *P. perspicillatus* in the Proceedings of that institution for 1899 (Vol. XII., p. 88), remarked that he had the following material upon which to base his studies, and which had been collected by Dr. Leonard Stejneger on Bering Island in 1882.

"Rostral portion of cranium in advance of the fronto-nasal hinge, with attached palatines.

"Lower mandible.

"Right ramus of lower mandible.

"Two nearly complete sterna.

"Right coracoid.

"Right humerus.

"Left humerus of another individual.

"Right ulna.

"Right fused metacarpals.

"Right fused metacarpals, very im perfect.

"Three pelves, lacking pubic bones.

"Left femur.

"Two left tibiæ.

"Right tibia.

"Two left tarsi.

"Second cervical vertebra.

"Third cervical vertebra.

"Ninth (?) cervical vertebra.

"The more important of these are figured on the accompanying plates, all figures being of natural size, and drawn by the author.

"The bones, although stained, are in a good state of preservation, being but slightly weathered, and all are from thoroughly adult individuals.

"For a better and briefer description of these bones they have been compared with those of an adult *Phalacrocorax carbo*, and the opportunity has been taken to test, to some extent, the value of the subgenera *Urile* and *Phalacrocorax*, by comparing at the same time the corresponding bones of *P. urile* and *P. dilophus*.

"The former bird is, for the species, large and the latter somewhat undersized, although adult.

"The rostrum of *perspicillatus* is nearly as long as in *carbo*, but much more slender, and is readily distinguished from it by the deep, lateral, longitudinal groove characteristic of the subgenus *Urile*.

"The under surface of the rostrum is less grooved, longitudinally, than that of *carbo* and much less so than that of *P. urile* (see Pl. XXIV., Figs. 13–21, and Pl. VI., Figs. 25–28).

"The palatines are as long as those of *carbo*, anteriorly narrow and posteriorly wider, conforming in pattern very nearly to those of *urile*, while *dilophus* resembles *carbo* in this respect.

"The trans-palatine angle is more rounded than in *carbo*, much more than in *urile*, resembling in this *dilophus*.

"The inner portion of the post-palatine is less produced ventrally than in *carbo*, and the pterygoid articulation wider and flatter than in *carbo*, the palatine thus lacking the keel present in *carbo*.

"The same differences are found between the same parts of *urile* and *dilophus*.

"The maxillo-jugal bar is as long as that of *carbo* but more slender.

"The lower mandible is slightly shorter and decidedly weaker than that of *carbo*, and the lower mandible of *urile* is proportionately still weaker than that of *dilophus*.

"The dentary portion of the mandible is more deeply grooved along the inner surface than that of *carbo*, being comparatively the same as in *urile*.

"The cutting edges of the mandible are comparatively straight as in *carbo* and *dilophus*, but *urile* differs from all three in having the mandible distinctly recurved.

"The sternum is transversely flatter than that of *carbo*, being a trifle more flattened even than that of *urile*. The carina is also shorter than in *urile*, but in size and general appearance the sterna of *perspicillatus* and *urile* resemble one another very closely.

"From manubrium to meso-xiphoid that sternum is 13 mm. shorter than that of *carbo*, being exactly as long as that of *urile*.

"The proportion of carina to total length is shorter than in either *carbo* or *urile*, the sternum from anterior end of carina to mesoxiphoid measuring 2 cm. less than that of *carbo* and 4 mm. less than that of *urile*.

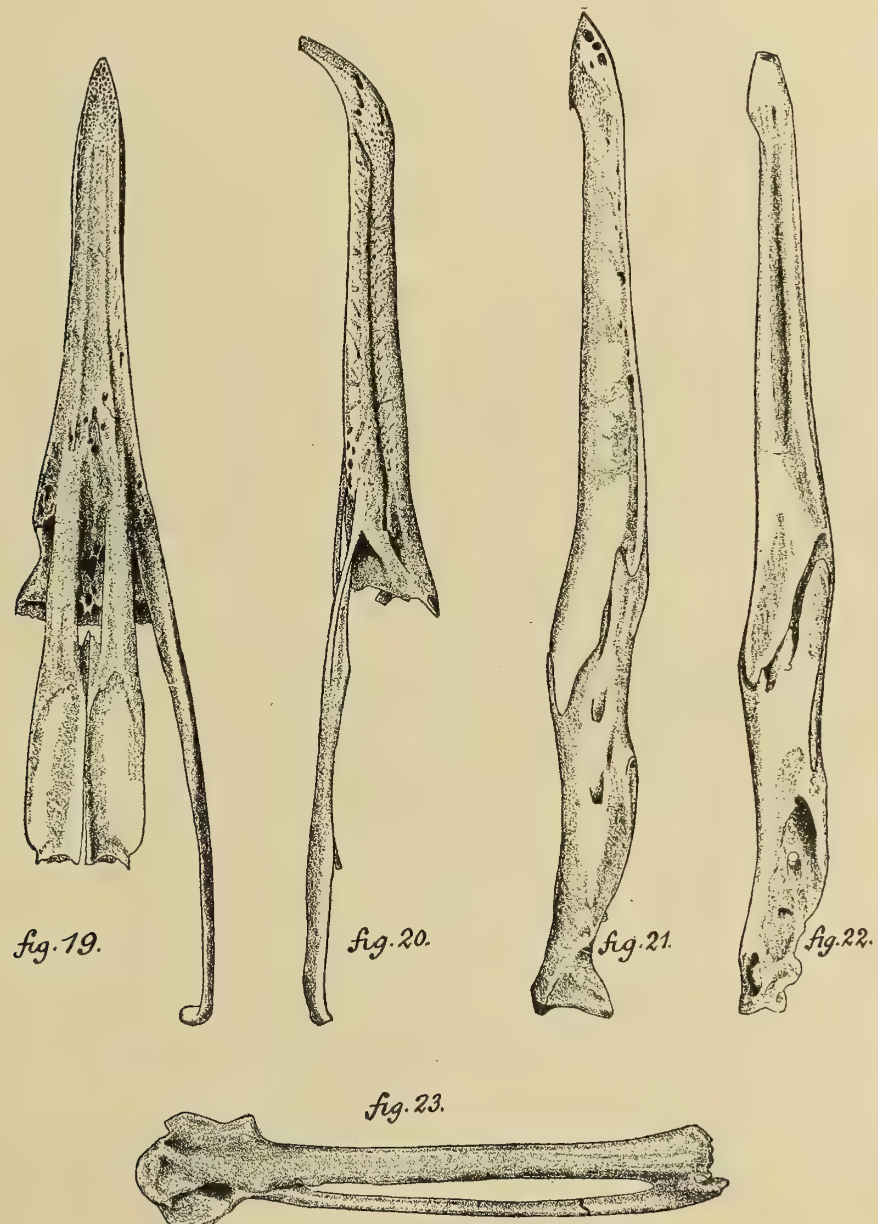
"Between the costal borders the sternum is slightly wider than in either *carbo* or *urile*.

"The rudimentary manubrium, like that of *urile*, lies in the plane of the body of the sternum, while in *carbo* and *dilophus* the manubrium lies in the plane of the keel.

"If a line be drawn between the costal processes it will be found that the coracoid articulations project less beyond this line and form a more obtuse angle with one another than they do in *carbo*, and the same is true of *urile* as compared with *dilophus*. The sternum is non-pneumatic, as in *urile*, but in *carbo* and *dilophus* good-sized foramina pierce its dorsal face just back of the ridge formed by the coracoidal groove.

"It is certainly interesting to find the sterna of these two representatives of the subgenera *Phalacrocorax* and *Urile*, respectively, agreeing with one another in these slight structural points.

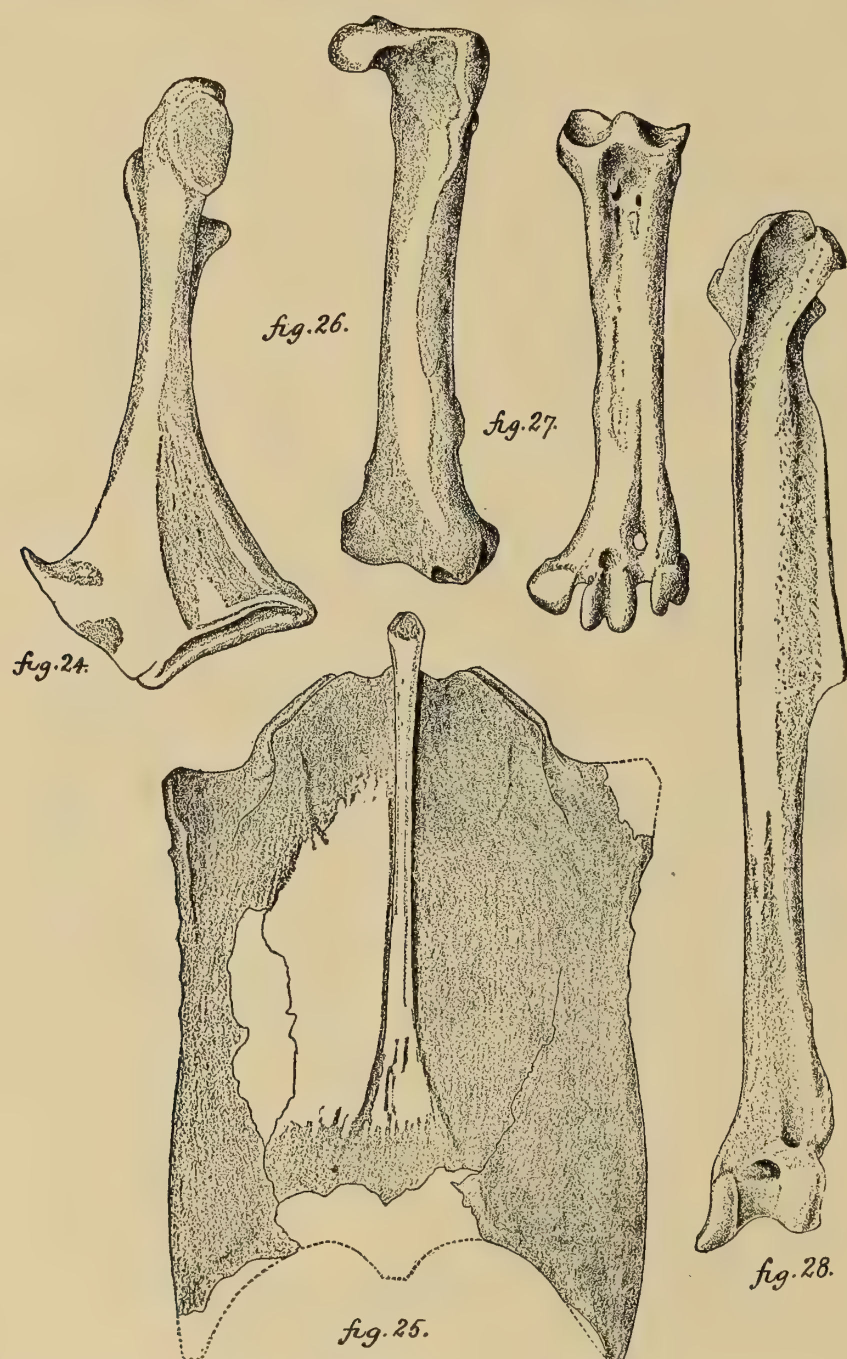
"Articulations are present for five pairs of ribs, the same number as in *carbo*. One specimen of *urile* has four pairs of articulations, another has five on the left side and four on the right, and *dilophus* has but four pairs of costal facets.



Bones of Pallas' Cormorant. Natural size. After Lucas.

FIG. 19. Ventral aspect of rostrum. FIG. 20. Lateral aspect of rostrum. FIG. 21. Right ramus of lower mandible, external aspect. FIG. 22. Right ramus of lower mandible, internal aspect. FIG. 23. Right metacarpals.

"The number of ribs articulating with the sternum is, however, subject to slight variations, especially among water birds, and without an extensive series of specimens it is a little difficult to be sure of the normal number.



Bones of Pallas' Cormorant. Natural size. After Lucas.

FIG. 24. Right coracoid, ventral aspect. FIG. 25. Sternum, ventral aspect. FIG. 26. Femur, anterior aspect. FIG. 27. Tarsus, anterior aspect. FIG. 28. Tibia, anterior aspect.

"The coracoid is of the same length as that of *carbo*, 10 mm. longer than in *urile;* but, while the proximal end is but little heavier than in *carbo*, the shaft and especially the distal end are much more massive.

"The epicoracoid is prolonged upward into a sharper hook than in any of the other species at hand, but this process is subject to considerable variation with age or in various individuals.

"One humerus is a little longer than that of *carbo*, the other is of exactly the same length; both are much stouter, especially in the proximate half.

"The humerus is practically non-pneumatic, the foramina being very minute, while the pneumatic foramina of *carbo*, though not large, are readily seen.

"The humerus of *urile* differs from that of *dilophus* precisely as that of *perspicillatus* from *carbo*.

"The ulna is distinguishable from that of *carbo* only by its greater weight, and the same may be said of the humerus of *urile* as compared with that of *dilophus*.

"The fused metacarpals are slightly shorter and slightly stouter than in *carbo*, and here again the same differences are observable between the metacarpals of *urile* and *dilophus*.

"The 'sacrum,' as a whole, is as long as that of *carbo*, but its component parts are more heavily built.

"It comprises six pre-sacrals, two true sacrals, and nine post-sacrals, and the three 'sacra' of *perspicillatus* agree with one another in these particulars.

"*Phalacrocorax carbo* has six pre-sacrals, two true sacrals, and nine or ten post-sacrals. *P. urile* has six, two, eight, and *dilophus* six, two, nine.

"The hypapophyses of the anterior three vertebræ have been broken off, but although the compressed centra are larger than in *carbo*, the hypapophyses seem to have been smaller.

"The six pre-sacrals present few salient characters, but the diapophyses of the fourth vertebra lie at right angles to the vertebral column, while in the three other species the diapophyses of this vertebra are directed forward.

"The sacral and immediate post-sacral vertebræ vary in the development of their parapophyses in all four species under consideration.

"In all three specimens of *perspicillatus* the two true sacrals bear no parapophyses, while the two succeeding vertebræ have them extended to, and anchylosed with, the ilium.

"The diapophyses and parapophyses of these vertebræ are united by a thin plate of bone, but that this is due to age is shown by the condition obtaining in the other species.

"These latter also indicate that the canal formed by these processes, the centra of their vertebræ and the ilium, is larger on the right side than on the left, and that it is the first obliterated on the left side.

"In *carbo* neither the sacrals nor the second post-sacral bear parapophyses, although these are present on the first post-sacral, uniting it firmly with the ilium.

"In one example of *urile*, slender, but well-marked parapophyses connect the two sacrals with the ilia.

"In another and much smaller specimen the second sacral has a parapophysis on the left side, there being no parapophyses on the first sacral.

"In both specimens of *urile* the first, but not the second, post-sacral bears parapophyses. Finally, *dilophus* has strong parapophyses on the second sacral and first post-sacral, but none on the second post-sacral.

"The variation in the sacral region of these specimens is not only interesting in itself, but interesting from the fact that it is unusual for parapophyses to be present at all on the true sacral vertebræ of birds.

"Viewed from above the ridge formed by the confluent spinous processes of the 'sacrals' is wider than in *carbo*, and the interpophysial foramina are nearly closed, while in *carbo* they are very open.

"Although these characters depend to some extent on age, they do not entirely, and the same differences exists between the 'sacra' of *urile* and *dilophus* as between those of *perspicillatus* and *carbo*.

"The pelvis is much more rugose than in *carbo*, all attachments for muscles being strongly emphasized.

"The anti-trochanter is placed further back than in *carbo*, and is much more rounded, thus affording more play to the femur.

"Just back of the anti-trochanter the outer edge of the ilium is raised and thickened, forming a flat, subtriangular spot, but proportionately smaller than in *perspicillatus*.

"Back of this flattened portion the dorsal edge of the ilium is bent outward, making this part of the ilium outwardly concave, where in *carbo* it is convex.

"The post-ilia of *carbo* and *dilophus* round gently outward and downward throughout their entire length from their junction with the diapophyses.

"Viewed from the side the dorsal outline of the 'sacrum' is slightly decurved, while that of *carbo* is very nearly straight and the same difference exists between *urile* and *dilophus*.

"The acetabulum is slightly larger and forms more nearly a perfect circle than in *carbo*.

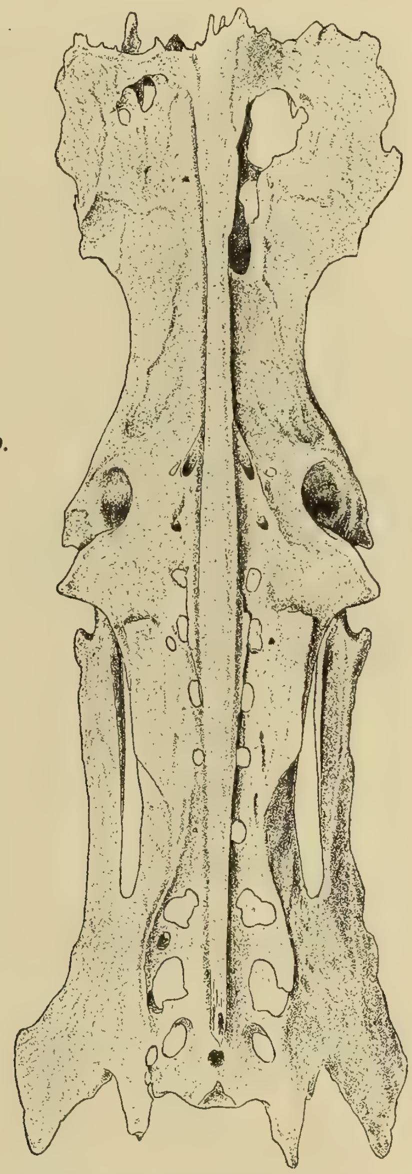
"The ilio-ischiatic foramen is subelliptical and wide, the longitudinal diameter being nearly twice the vertical, while in *carbo* this foramen is more pointed posteriorly and narrower, the length being more than three times the height.

" In consequence of the size of this foramen the distance from the dorsal edge of the ilium to the ventral edge of the ischium is much greater than in *carbo.*

"The bar of the ischium bounding the obturator space is sharp-edged, rugose, and concave exteriorly on the posterior portion, while the corresponding portion of the ischium in *carbo* is comparatively smooth and slightly convex posteriorly.

Fig. 29.

Fig. 30.



Bones of Pallas' Cormorant. Natural size. After Lucas. FIG. 29. Left lateral aspect of pelvis. FIG. 30. Dorsal aspect of pelvis. The long, sweeping post-pubic bone was broken off and lost from this bone when it was discovered.

"The posterior border of the ischium is straighter than in *carbo* and the ilio-pubic articulation one third shorter.

"The femur is 5 mm. longer than that of *carbo*, in every way much more massive, and with all the muscular ridges more pronounced, while curiously enough it is more pneumatic, having several foramina in the ventral aspect of the neck that are lacking in *carbo*.

"There is nothing to distinguish the femur of *urile* from one of *dilophus* of the same length, and of the two that of *dilophus* is slightly the heavier.

"But in the specimen of *urile* in which the humerus corresponds in length to that of *dilophus*, the femur and tibia are both longer and heavier than in *dilophus*, and the tarsus a little lighter.

"The phalanges, again, are more massive in *urile* than in *dilophus*.

"The smallest of the three tibiæ is slightly longer than that of *carbo*, the cnemial crest is more expanded, and the cnemial ridges farther apart and more pronounced.

"The distal extremity of the tibia is also wider than in *carbo*, but at its smallest diameter the shaft is no larger.

"The muscular ridges and grooves are more marked than in *carbo*, but in the absence of more material and making due allowance for individual variation, it is difficult to point out characters which definitely distinguish the tibiæ of the two birds.

"The tarsus is of the same length as in *carbo*, but much wider, and, as throughout, with all the ridges more pronounced.

"Little can be said concerning the three cervical vertebræ, except that, unlike the other bones, they are less strongly built than the corresponding bones in *carbo*.

"From the foregoing notes it will be seen that the differences existing between corresponding bones of *perspicillatus* and *carbo* also exist between the same bones of *urile* and *dilophus*, and that conversely *perspicillatus* and *urile* agree with one another as do *carbo* and *dilophus*.

"The subgenera *Phalacrocorax* and *Urile*, therefore, seem to rest on good structural foundations, each being characterized by internal as well as external characters.

"Unfortunately no skull of *perspicillatus* is to be had, but the crania of *carbo* and *dilophus* agree with one another, while differing strikingly from the cranium of *urile*.

"From the harmony of the other parts its not assuming too much to suppose that the skull of *perspicillatus* would resemble that of *urile*."

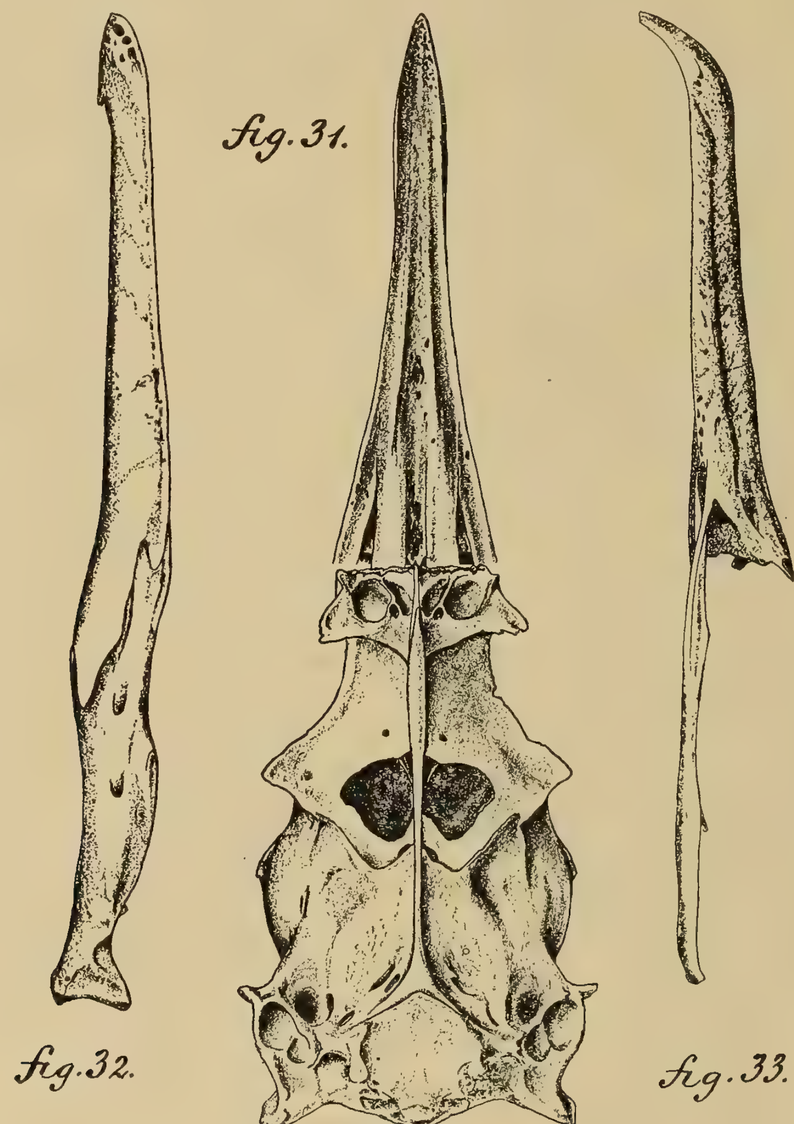
"With the exception of the sternum the greater size of the bones distinguishes those of *perspicillatus* from those of *urile*, while well-marked differences of shape or proportion exist between the corresponding bones of *perspicillatus* and *carbo*.

MEASUREMENTS (IN MILLIMETERS) OF CORRESPONDING BONES OF PHALACROCORAX PERSPICILLATUS, CARBO, URILE, AND DILOPHUS. [FROM LUCAS.]

(All measurements are in a direct line and not along curves.)

	P. perspicillatus (National Museum, 17041).	*P. carbo* (Yale College Museum, 535).	*P. urile* (National Museum, 12502).	*P. dilophus* (National Museum, 18050).
Rostrum:				
Tip of mandible to extremity of maxillo-jugal bar	134	140	108	105
Maxillo-jugal bar	68	69	56	56
Tip of mandible to posterior end of palatine	109	117	91	86
Width across nasals, at fronto-nasal hinge	21	20	13	14
Lower mandible:				
Length of ramus	139	144	112	110
Greatest height of ramus	13	13	9	12
Sternum:				
Anterior end of carina to mesoxiphoid	104	119	97	91
Manubrium to mesoxiphoid	83	97	84	76
Depth of carina	28	33	31	26
Width across articulations of first rib	64	66	64	54
Width across articulations of fourth rib	63	59	60	51
Coracoid:				
Length	84	87	71	70
Breadth of sternal articulation	25	25	24	20
Greatest distal breadth	18	17	16	13
Humerus:				
Length	170	170	140	140
Greatest proximal breadth	30	28	25	23
Greatest diameter of shaft midway between extremities	11	9	10	8
Greatest distal breadth	21	20	18	17
Ulna:				
Length	190	178		
Greatest proximal breadth	21	18		
Greatest diameter of shaft midway between extremities	8	7		
Pelvis:				
Greatest length of ilium	151	152	122	120
From anterior border of ilium to external angle of anti-trochanter	72	65	58	49
Greatest width of ilia in advance of acetabula	48	44	42	38
Least width of ilia in advance of acetabula	23	23+	19	18
Width between outer extremities of anti-trochanters	43	46	37	33
Length of ilio-ischiatic space	42	41	32	38
Greatest width of ilio-ischiatic space	18	13	13	10
From dorsal edge of ilium, above the ilio-ischiatic foramen, to ventral edge of ischium	28	23	23	19
Length of ilio-pubic articulation	21	28	15+	23
Between posterior terminations of ischia	46	40	42	40
Femur:				
Length	74	70	66	55
Greatest proximal width	21	19	16	15
Greatest diameter midway between extremities	11	10	9	8
Greatest distal width	22	18	16	15+
Tibia:				
Length	140	127	117	102
Width across cnemial ridges	15	13	11	11
Width at distal end of articulation with fibula	15	13	11	13
Least transverse diameter of shaft	8	8	7	7
Distal width	16	15	12	13
"Tarsus":				
Length	71	72	60	62
Proximal transverse width	19	16	14	14
Distal width	20	18	15	14

"*P. perspicillatus* appears to have been a much heavier bird than *carbo*, and a bird of weaker flight; with more robust and muscular legs, and a more slender and more feeble head and neck.



Skull and Jaw-bones of Pallas' Cormorant. (After Lucas.)

FIG. 31. *Phalocrocorax perspicillatus,* inferior aspect of cranium. The anterior and posterior portions are from different individuals. (Nat. size.)

FIG. 32. *Phalacrocorax perspicillatus,* left ramus of jaw, external aspect. (Nat. size.)

FIG. 33. *Phalacrocorax perspicillatus,* mandible and left palatine, external aspect. (Nat. size.)

"In comparing the tables of measurements it must be said that they do not adequately convey the impression produced by a comparison of the bones themselves. Thus, in the measurements of the lower mandible the greatest vertical width

is comparatively as in *carbo*, but from this point the ramus tapers rapidly either way so that, as a whole, the mandible is much weaker than that of *carbo*.

"So too with the humerus, where the greatest proximal width is only 2 mm. greater than in *carbo*, although the bone in its entirety is much more stoutly built."

In a following volume of the Proceedings of the U. S. National Museum, in which Mr. Lucas described the above specimens of bones of *P. perspicillatus*, he on subsequent pages also described the skull of this species, and presented other data of importance having reference to the *Phalacrocoracidæ* (Vol. XVIII., pp. 717–719, Pls. XXXIV.–XXXV.).

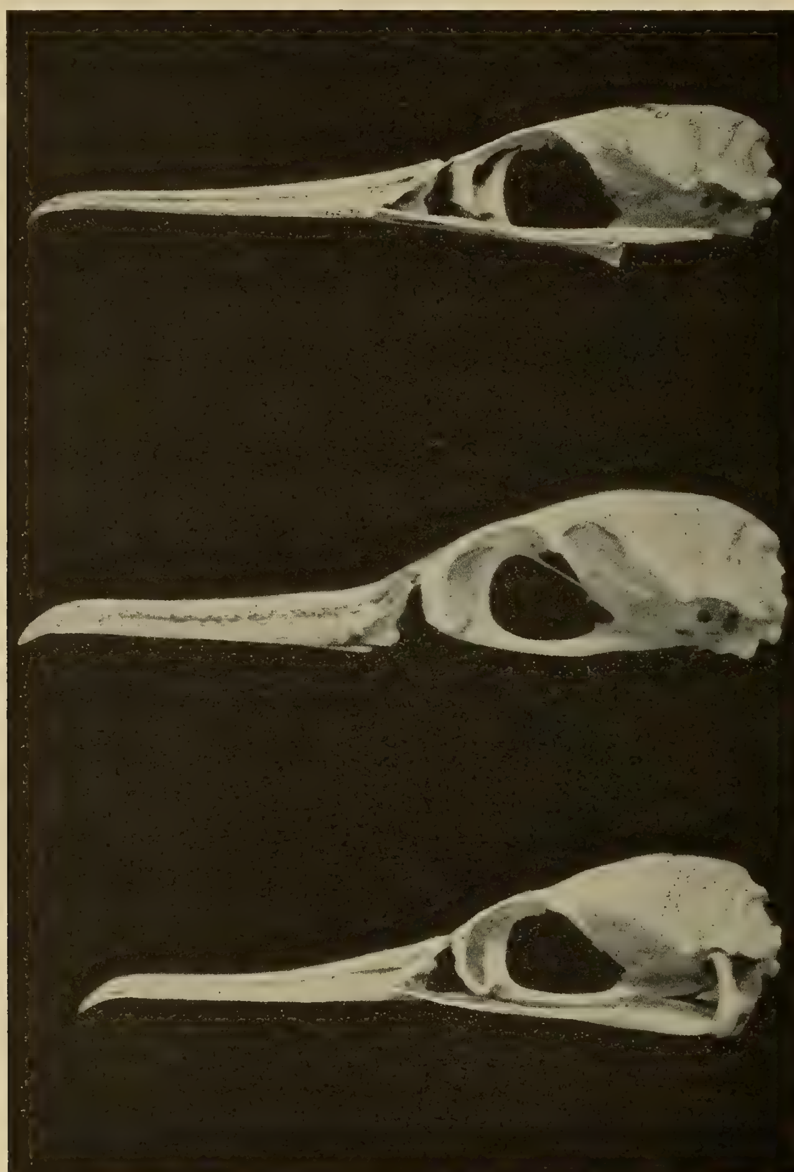
This second lot of bones were likewise obtained by Dr. Stejneger at Bering Island in 1895, or thirteen years after the first specimens were collected by him. A cranium and a sternum of *P. perspicillatus* are found in this second installment, and they are very important discoveries.

The cranium is now in the collection of the Museum (No. 19417, U. S. N. M.). "In its general contour," says Mr. Lucas in his paper referred to above, "it most closely resembles that of *P. penicillatus* among existing cormorants, but is decidedly larger, and is proportionately wider than in that species, while the beak is shorter. As far as mere size is concerned, the skull of an adult male of *P. carbo* would be as long as that of *P. perspicillatus*, but the latter is much wider and is more depressed. The cranium is readily distinguished from that of *P. urile* by its greater size and less depression, and by having a proportionately stouter beak, whose ridge lacks the slight but characteristic emargination found near the base of the beak in *P. urile*.

"As a matter of fact, the differentiation of cormorants into species with grooved beaks and those without does not exist, so far as the bony beak is concerned. Some have deeper grooves than others, but all have more or less of a furrow along the side of the mandible, and there is every degree of gradation, from such well-furrowed beaks as those of *P. albiventris* and *P. magellanicus* to the shallow grooves of *P. melanoleucus* and *P. carbo*.

"Pallas's Cormorant shows a marked difference from all others examined in the development of the lateral ethmoid. In other species the lachrymal sends a process inward which fuses with a spur from the mesethmoid to form a more or less L-shaped bar of bone, uniting the frontal and mesethmoid. A small spur, arising from the inferior inner angle thus formed, represents the lateral ethmoid, and this is usually but little developed, being largest in *P. penicillatus* and obsolete in *P. urile*. In *P. perspicillatus* there is a lateral ethmoid plate, complete save for an opening above, being the retention by ossification of a cartilaginous plate found in the nestling of *P. urile* before the nostrils have become closed. The maxillopalatines are also

slightly better developed than in any existing cormorant, and while the difference is small, still it does exist, and here again it is seen by comparison to be the development of a character found in young birds.



Crania of various Cormorants. (After Lucas.)
FIG. 34. *Phalacocorax penicillatus.*
FIG. 35. *Phalacrocorax perspicillatus.*
FIG. 36. *Phalacrocorax carbo.* (Two thirds natural size ; from photographs.)

"Difference exist between *P. perspicillatus* and other cormorants by the presence of a narrow bar of bone forming two precranial cavities where but a single opening

exists in allied species, and in the comparatively small size and regular lyrate form of these openings. From these conditions it will be seen that there is in the cranium an excess of ossification over that found in other cormorants. While no bar of bone has been found in other species, there are hints of it in some, thus, *P. penicillatus* and *P. magellanicus*, in the shape of a little bony spike running upward from the alisphenoids, and it is not impossible that the complete bar may be found in some very old individual. This is the more probable because in the young, of *P. urile* at least, there is a bar of cartilage occupying the place of the bar of bone found in Pallas' Cormorant.

MEASUREMENTS[13] OF SPECIES OF PHALACROCORAX.[14] [FROM LUCAS.]

STERNUM.

	P. perspicillatus, male (U. S. N. M., No. 19417).	*P. carbo*, male (Yale College, No. 535).	*P. penicillatus* (U. S. N. M., No. 18535).	*P. urile*, male (U. S. N. M., No. 12502).
	mm.	*mm.*	*mm.*	*mm.*
Anterior end of carina to mesoxiphoid	132[15]	119	101	104
Manubrium to mesoxiphoid	109	97	87	90
Depth of carina	40[15]	33	22	25
Width across articulations of first rib	84	66	60	70
Width across articulations of fourth rib	72	59	58	65

SKULL.

	P. perspicillatus, male (U. S. N. M., No. 19417).	*P. carbo*, male (U. S. N. M., No. 18851).	*P. penicillatus* (U. S. N. M., No. 940).	*P. urile*, male (U. S. N. M., No. 12502).
	mm.	*mm.*	*mm.*	*mm.*
Tip of mandible to occipital condyle	148[16]	135	141	116
Fronto-nasal hinge to articulation for occipital style	69	61	62	55
Across anterior part of frontals	22	20	19	13
Across postorbital processes	39	31	32	25
Across squamosal processes	45	36	37	32
Across exoccipital processes	40	33	33	26

"The sternum (No. 19417, U. S. N. M.) found with the present series of bones is important, as its size indicates it to be that of a male, and shows the sternum previously described to have been that of a female, or possibly even that of a male of *P. urile.* It is very much larger than any sternum of *P. urile,* and much larger even than the large specimen of *P. carbo*, used for comparison.[17] The present sternum is

[13] The measurements are in a straight line.

[14] Proc. U. S. Nat. Mus., XII., 1889, p. 88.

[15] Estimated, owing to breakage.

[16] Taken from rostrum of one bird and calvarium of another.

[17] Proc. U. S. Nat. Mus., XII., 1889, pp. 88-94.

thus in harmony with the other bones, and aids materially in emphasizing the superior size of *P. perspicillatus*.

"The appended tables give the measurements of the cranium and sternum here described, compared with the corresponding parts of other species. The measurements of the previously described sternum, ascribed to *P. perspicillatus*, are repeated and an error of the first-given table corrected. The length from anterior end of carina to end of mesoxiphoid is said to be 104 mm., when it should have been 90 mm.

Unfortunately the skull of *P. carbo* now available is smaller than that of the individual used as a term of comparison in the previous paper[18] on Pallas' Cormorant."

Additional information in regard to the osteology of the *Phalacrocoracidæ* will be found further on in the present memoir, as well as under the explanation of the plates at its close.

Osteology of the Pelecanidæ.

(Plate XXVII., Figs. 31–41; Plate XXVIII., Fig. 42, and Plate XXX., Fig. 49.)

Sometime during the year 1864, the writer collected on Indian Cay of the Bahama Banks, a fine adult male specimen of *Pelecanus fuscus*. From it I took the skull, and have it before me at the present writing.

Measuring from the transverse cranio-facial groove we find the osseous superior mandible in this specimen to be somewhat less than four times as long as the remaining part of the skull. A vertical section made through the middle of the posterior third of this mandible at right angles to its long axis gives an elliptical figure, with the minor axis in the horizontal plane. The anterior two thirds has a sharp lateral edge, while the extremity is armed with a powerful decurved hook. About half of the fore part of this enormous beak is compressed from above downward, a compression that is accompanied by a gradual widening of the bone to near the end, where it slopes in toward the hook in the median line.

The maxillo-palatines constitute a great spongy mass that fills up a space anterior to the rhinal chamber. They unite in the median line, are bounded above by the premaxillary, below by the united palatines, while the anterior extremity of the maxillary fuses with the mass at about its middle on either side. (Compare with Figure 36, Plate XXVII.)

In form this maxillo-palatine mass is wedge-shaped, with the broad end anchylosed with the under side of the united nasal processes of the premaxillary.

[18] *Loc. cit.*

Posteriorly its wall is composed of compact tissue, being at right angles to the longitudinal axis of the skull. It slants from the under side of the cranio-facial hinge to the anterior margin of a median foramen, seen just anterior to the keel which is formed by the union of the palatines behind.

This posterior maxillo-palatine wall has a cleft in its lower two thirds, while two conical pits, placed side by side, lined with compact osseous tissue, occupy its upper third. They have their bases opening in the rhinal chamber, and their apices are pierced by the small subcircular nostrils, one in each conical passage.

The hinder half of the jugal bar is compressed from side to side, slightly dilated, with its end crooked up, and in life simply bound to the upper and outer side of the quadrate.

The body of a *lacrymal* fuses completely with the cranial elements above, its upper surface assisting in forming the smooth superfices of the frontal region. This is also the case in *P. sharpei* (Pl. XXVII., Fig. 37). From this portion it sends downward and slightly backward a descending process. This is composed of a cylindrical pedicel for its upper third and an antero-posteriorly compressed portion for the lower two thirds. It fails to reach the maxillary, its tip remaining free just above that perpendicularly compressed bar which passes immediately beneath it.

The interorbital septum is entire, with the exception of a semicircular perforation, which is immediately in front of the aperture in the anterior wall of the braincase that gives egress to the optic nerves.

Each olfactory has a small foramen in either orbit at its usual site; the track for the nerve being a broad, shallow groove beneath the orbital vault.

The *mesethmoid* is very deep; its anterior border is sharp and thin. Commencing in the aperture of the angle between the pterygoidal shafts, it is carried directly upward and forward to the expanded portion beneath the roof of the cranio-facial region, the edge meeting the median division of the maxillo-palatines. (For figures illustrating the skull of the Brown Pelican see my memoir on the "Osteology of the Tubinares and Steganopodes," Proceedings U. S. Nat. Museum, 1888, Vol. II., pp. 311–315.)

The lower fourth of this ethmoidal border is thickened and rounded for the articulation of the palatine and pterygoidal heads.

Coming, as usual, from the anterior apex of the basi-temporal triangle, the other portion of the rostrum is decurved and meets the point referred to above in the angle between the pterygoids,

A *quadrate* is a very large bone with a broad, triangular process. Its mastoidal head can hardly be said to be divided into two, as in most birds, for the division is

so very slight and faintly marked; and a large pneumatic foramen is seen upon its outer side—a very unusual place for this aperture.

Its mandibular foot is narrow antero-posteriorly and very wide transversely. Two facets occupy its lower surface, separated from each other by a concave notch which is deepest anteriorly.

The bone also presents a smooth articular surface for the quadrato-jugal at the point above mentioned, while a large convex facet is offered to the pterygoidal cup of the pterygoid of the corresponding side.

We find the external openings to the ear to be very small, and hid from sight upon direct lateral view by the quadrate. A sphenotic process is well developed, but the mastoidal one is simply a roughened line; between the two is a wide crotaphyte valley leading from the fossa of the same name, which is here small, inconspicuous, and entirely lateral.

The orbital cavity itself is thus seen to be deep and capacious, lacking bony walls principally upon its inferior and anterior aspects. They are more complete in *P. sharpei* (Pl. XXVII., Fig. 37).

Upon its under side this skull presents a number of points of interest. The anterior moiety of the superior mandible is here seen to be longitudinally grooved by a broad and shallow furrow, which gradually becomes somewhat narrower as we proceed backward, to finally merge into the convex median portion of the hinder half of this great rostrum. Along its median line it is marked by a few scattered, slit-like foramina that lead into its shallow interior, which latter is largely filled with an open mass of spongy, osseous tissue, continuous with the maxillo-palatines behind.

The palatine bodies, including their heads, fuse together for their entire extent in the median plane. Resulting from this union we have a single, descending, median carination, composed of the united inner keels of the palatine bodies and a similar superior median one composed of the ascending processes of the same.

The latter is truncated just before reaching the maxillo-palatine bodies.

This skull lacks basi-pterygoid processes, while the pterygoids themselves are short, thick set bones, with large anterior and posterior heads, and sharpened longitudinal crests on the superior aspects of their shafts.

The basi-temporal triangle is small and its area concave. A thin, pointed lip of bone eaves over the entrance to the Eustachian tubes, which are here apparently thoroughly surrounded by bony walls.

We find the foramen magnum situated at the bottom of a broad, deep, and transverse concavity. This excavation is bounded on either side by the dome-like mastoid prominences, in front by the line of the base of the basi-temporal triangle,

and behind by a low, smooth ridge which arches between its lateral boundaries. The foramen magnum cannot be seen on a direct vertical view of the base of the skull (Pl. XXVII., Figs. 35 and 36).

The occipital condyle is rather large, ellipsoidal in form, and placed transversely, while the outline of the foramen is also a broad ellipse, but with its long axis placed just the other way. The plane passing through its periphery makes an angle with the plane of the basis cranii of about sixty degrees.

Regarding this skull from a superior aspect we are to note the small, subcircular openings to the nostrils, situated a little beyond the irregular line marking the cranio-facial hinge (Pl. XXVII., Fig. 40).

Their centers are about 2 mm. apart, and each one is situated at the posterior end of a groove. These grooves extend the entire length of the superior mandible, passing out on either side of the hook at its anterior extremity. At first each is rather on the lateral aspect of the bone, but beyond the posterior half they gradually converge and get on top, to include between them the prominent convex culmen. Just before reaching the hook, however, the included surface becomes flat and depressed, when the lines terminate, as pointed out above.

The top of the skull in this Pelican is very flat for the frontal region, being simply curved downward at the outer borders. As we proceed backward to the parietal region, however, it gradually becomes more convex and dome-like, though still retaining its absolutely smooth and polished character. This latter may also be seen from a posterior aspect, and below it the high, arching, and equally smooth occipital area. This latter extends down on either side over the enormous mastoidal elevations of this bird. We also notice that from this view we may see directly into the foramen magnum; the entire pterygoids are in sight, and the quadrates come down far below the basi-cranial plane.

The *mandible* from the skeleton of this Pelican is represented by a long, narrow loop of bone, which is strikingly devoid of prominent characters. Its symphysis is very short and decurved, being slightly excavated on its superior aspect behind (Pl. XXVII., Fig. 41).

The upper and lower margins of either ramus are rounded for their entire length, while the sides included between them become gradually narrower as we proceed in the direction of the symphysis. These are smooth both internally and externally and both concave in the vertical direction.

Rather more than the posterior moiety of each ramus is hollow for the admission of air, and each presents two foramina, which seem to be intended for that purpose. One of these is on the inner and upper aspect of the ramal shaft, just beyond

a concavity that occurs immediately anterior to the articular cup. The other, elliptical in form, is on the inner and lower aspect, and about 2 cm. beyond it.

Each articular cup presents two concavities—a central one and another occupying the inturned process of this extremity. Both have pneumatic foramina at their bases. The mandibular angle behind is truncate and much compressed in the perpendicular direction. The under surface of one of these ends is perfectly smooth and gradually merges into the inner and outer surface of the ramal shaft. Almost complete disappearance of the coronoids has taken place.

Almost the entire skull of this bird is highly pneumatic, and I have carefully compared it with the specimen loaned me by the U. S. National Museum, and find that they agree in all essential particulars. In the latter I find a mandible 38 cm. long, while the symphysis of the same only measures 4 mm. The superior carination of the united palatines is somewhat higher, especially in front than in my own specimen, but I am inclined to believe that in mine the free margin has somewhat broken off, and due allowance should be made for it in the figure illustrating the skull of this bird in my earlier memoir (Fig. 40) showing the lateral view of the Pelican's skull, when the supero-median palatal keel is drawn a little too low.

Fig. 20 of Huxley's 1867 paper in the P. Z. S. is a good representation of the posterior half of the skull of a pelican (*P. onocrotalus*) seen upon its basal aspect. The side view of the same is very indifferently drawn.

Some few of the small bones of the disarticulated National Museum specimen at my hand may have been lost, but none of any consequence. Almost the entire skeleton is pneumatic, and exceedingly light. The pygostyle is as light as a wafer, and taken with all the caudal vertebræ, only weighs a few grains. Among the non-pneumatic bones we note the atlas, the fibulæ, the first metatarsal, and all the toe-joints. Some of the bones are actually riddled with air-holes, and such a long bone as the humerus has many minute foramina at very various localities at both of its extremities. The pelvis weighs no more than were it made of cork, and so it is with all the other large bones.

Of the Remainder of the Axial Skeleton in Pelecanus.

(See Plate XXVII., Figs. 31–34, 38, 39; Pl. XXVIII., Fig. 42, and Pl. XXX., Fig. 49.)

Professor Mivart found in the spinal column of a specimen of *Pelecanus mitratus* in the British Museum but "forty vertebræ in all, there being but three lumbar and five caudal"; and in a specimen of *P. onocrotalus* (No. 527A), forty one vertebræ, there

being but three sacro-caudals. He says, however, that in this species the general number seems to be forty-two vertebræ in all, not counting the pygostyle.

In a complete skeleton of *Pelecanus fuscus* before me (No. 18483), I find sixteen true cervical vertebræ, none of which support true ribs. The seventeenth bears a pair of large, well-developed ribs which do not connect with the sternum, and which have long epipleural appendages low down on their shafts, where they are anchylosed. The eighteenth vertebra is the ultimate one of the dorso-cervical series of the spinal column that is free. Its ribs are broad and flat, with their appendages coössified to the shafts at an angle of 45°, and inclined to be slender, narrow, and pointed.

The nineteenth, twentieth, and twenty-first vertebræ are not only all fused together, but are similarly joined with the bones forming the pelvic "sacrum." This union is most perfect, and is considerably fortified by the complete coössification of the metapophyses extending between the extremities of the transverse processes, and then with anterior iliac borders, in which location the ossifying process has been extended quite across, thus, on superior aspect, shutting the twenty-first vertebra out from view.

These three vertebræ also bear broad and flat ribs, connecting with the sternum as do all the thoracic ribs in this Pelican. This pair belonging to the nineteenth vertebra are quite like those described above for the eighteenth; they are broader, however, which is also the case with the pair suspended from the twentieth vertebra. These last have the epipleural spines reduced in size, while the last two pairs of ribs, or those belonging to the twenty-first vertebra, and the pair of "pelvic ribs" lack these appendages entirely.

Almost completely pneumatic in character, the leading *costal ribs* are rather short, but the series gradually increases in length as we pass backwards, all of them being more or less pneumatic, and all being remarkable for having their extremities enlarged, for the purpose of affording a greater articulatory surface at those points. For the most part, the pneumatic foramina in these hæmapophyses are to be found at their sternal ends.

The free pelvic vertebræ all have a swelled appearance, while their surfaces are as a rule smooth, their salient angles much rounded off, and their processes quite subordinated.

The cup of the *atlas* is deeply notched above, as is the articular surface of the body behind, concaved upon the same aspect. This surface is of an elongo-reniform outline, its transverse diameter being of the greatest length. A small hypopophysial tip extends backwards from its mid-point below.

Not especially stout, the lateral pedicels support a broad, oblong neural arch, which has a straight anterior, and a concave posterior margin. Air gains access to this vertebra through some holes situated in or near a small concavity, over which articulates the ventral surface of the odontoid process of the axis when the bones are *in situ*. A polishing of the surface alone indicates the points where the anterior margin of the neural arch comes in contact with the occipital bone of the cranium, and where the ventral aspect of its posterior margin rides on the upper part of the anterior margin of the neural canal of the axis.

A broad-based, swollen, and tuberous neural spine is one of the chief characters of the last-named vertebra, while its hæmal spine, situated posteriorly on the centrum, is transversely compressed, sharp along its infero-mesial border, and withal rather inconspicuous.

The articular surface on the body for the atlas is deeply concave, and always presents a large mesial pneumatic foramen at its base, just beneath the odontoid process. Posteriorly, the neural arch of this vertebra far overhangs the centrum below, while either postzygapophysial portion of it, not strictly defined from the bone, has upon its direct ventral aspect a large oval articular facet for articulation with the corresponding ones at the prezygapophyses of the third vertebra.

We have no lateral canals in the axis vertebra of this Pelican, but a small pneumatic foramen is usually seen on either side, at the site of their occurrence in the next bone of the spine behind it, at points where they open posteriorly. In the third, fourth, fifth and sixth vertebræ the neural spine is represented by a low, lengthy, and thickened ridge, which fails in any case to reach the dorsal margins of the neural canal, either in front or behind. In the seventh vertebra the neural spine is much restricted, occupying only the center of the bone. It begins to disappear in the eighth ; is almost absent in the ninth and tenth ; feebly reappears in the eleventh and twelth; begins to be tuberous in the thirteenth; and from this on it slowly assumes the form it has in the dorsal series, where it is low, thickened, and wedge-shaped, with base behind and apex in front.

Far back on the centrum of the third vertebra we find a short, thick, and low hæmal process; somewhat resembling the one on the axis. The character is quite obliterated in the fourth vertebra, where we begin to see, anteriorly beneath the extreme fore part of the centrum, the first indications of the formation of the carotid passage. They are more distinct in the fifth vertebra; still more so in the sixth; decidedly so in the seventh, where the remarkable peculiarity exists in that a carotid channel with thin, conspicuous side-walls abruptly develops at the extreme hinder end of the centrum. This character is just as well marked in the eighth vertebra,

after which it gradually disappears (never to form a completed tube), to be gone entirely in the thirteenth cervical.

In the eighth vertebra the anterior part of the carotid passage is a solid, closed tube, its parapophysial walls being thick and strong, the passage of considerable caliber, and the whole occupying more than the anterior third of the ventral aspect of the bone. It also shows, ventrad, a mid-longitudinal ridge, with a longitudinal gutter upon either side of it. This carotid canal remains a closed tube to include the fourteenth vertebra, slowly changing in character as we near the dorsal series. In the fifteenth to the seventeenth inclusive, its place is taken by a well-marked hæmal spine—a character entirely absent in the eighteenth vertebra, which is a true dorsal one.

No evidence of a hæmal spine whatever exists in the three fused dorsal vertebræ, and in them the neural spine is but represented by a coössified, flattened ridge, hardly at all higher than the fused metapophysial track at the ends of the diapophyses, on either hand. Lateral canals begin in the third vertebra and persist to the sixteenth inclusive. They are long and of small caliber in the third, fourth, fifth and sixth, materially shortened in the seventh; somewhat more so in the eighth, where, for the first time, their anterior opening looks directly dorsad, which latter continues to be the case in the ninth, tenth, eleventh, twelfth, thirteenth and fourteenth, the canals increasing in caliber, but at the same time shortening in length as we pass through the series just named. In the fifteenth and sixteenth vertebræ, the lateral canals are parallel with the neural canal, about one third smaller in size, their ventral floors being formed by the pleurapophysial elements. For the most part the comparatively rather small neural canal is subcylindrical in form, being most compressed vertically as we pass towards the distal cervicals, to become more cylindrical again in the ultimate free dorsal. After passing the fourth cervical, and from thence on to include the sixteenth, this tube is markedly of greater caliber behind than it is in front, in any single vertebra of this part of the spinal column.

This character can be particularly well seen in the eleventh cervical. Throughout, the parapophysial styles are very short. On the third vertebra they are far apart, but gradually approach each other and the median line to include the sixth cervical. Their character changes in the seventh, where they become sharp, short, and spiculiform. In the eighth, ninth and tenth they are represented by mere spinelets, close together mesiad and are to be found on the postero-ventral border of the carotid canal. From this on they gradually separate again, and entirely disappear from the ultimate cervical vertebræ.

The prezygapophysial facets are long, narrow and ellipsoidal in form on the third cervical, being considerably nearer each other at their posterior ends than they are in front. They face almost directly dorsad. As we pass to include the seventh cervical these facets gradually become more and more circular in outline, and incline to face towards the median plane. This they do quite abruptly in the eighth cervical—distinctly so in the ninth, look slightly backwards in the tenth, but again thereafter gradually right themselves so as to once more face the median plane. Here it will be seen we have the same arrangement noted for the Cormorant and the *Anhinga* though not nearly so well marked. The postzygapophyses are short and stumpy in the fourth vertebra, but very gradually lengthen to include the twelfth cervical, after which they once more shorten, to become short and thick-set again in the last cervicals, and the free dorsal, in which last—as distinct processes—they are practically aborted. Their facets for articulation with the corresponding ones on the prezygapophyses, are upon their ventral aspects, and of course have an exact counter-facing to them.

These vertebræ commence to lengthen after passing the third cervical, becoming quite longish and narrow in mid-series—they then very gradually assume the broad, massive, and short type found at the end of the cervical chain and in the free dorsal. Though these latter are large they agree with all the others of the column, from their extreme pneumaticity, in being very light in weight.

The three last dorsal vertebræ coössify, or rather in the adult Pelican are fused with those of the pelvic sacrum, and the leading vertebra of the latter is quite similar to one of the last dorsals, but in the next three the parapophysial processes are thrown up against and completely fused with the ventral surfaces of the ilia upon either side. These processes are spine-like and nearly aborted in the next following one, while in the next three they are absent entirely. This is well shown in the pelvis of *Pelecanus sharpei* (Pl. XXX., Fig. 49).

Then comes a true sacral vertebra, which has them long and well-developed, reaching out to points posterior to the acetabulæ where they fuse and broaden, and otherwise develop bone which greatly strengthens the pelvis in all this vicinity. The five remaining vertebræ of the "pelvic sacrum" also possess parapophysial processes, which with the diapophyses above them, most completely coössify with the internal borders of the ilia upon either hand. Of good capacity, the "pelvic basin" is of a short, oblong form, being one third narrower than it is long, and of nearly uniform depth throughout. Viewed laterally, we find the acetabulum to be large and circular; its internal periphery coequal with its external one. Above it is a fair-sized antitrochanter, facing forward and downward, and very slightly outward.

The obturator foramen merges completely with the obturator space, which latter is large and broadly spindle-form in outline. No prepubis is present, and the post-pubic style is curved and very slender until it comes in contact at a point on the postero-ventral angle of the ischium, after which it is turned slightly mesiad and somewhat though not at all greatly enlarged.

An extensive, subelliptical ischiadic foramen monopolizes much space on this lateral aspect of the pelvis. Behind it the surface of the bone is smooth, and finally we notice a broad, shallow notch on the posterior border, between ilium and ischium. Dorsad, the pelvis is broad, smooth and flat, with a thorough fusing of all the bones composing it. Parial foramina occur between the diapophyses of the uro-sacral vertebræ only in the post-acetabular region, where they are of good size.

The ultimate vertebra may be more or less individually outlined, and simulate in form the leading one of the caudal series. In the pre-acetabular region the ilia are moderately concaved, lie more or less in the horizontal plane, and fail to come quite in contact with each other over the "sacral crista," which latter is here quite low and indistinct, due to the thorough fusing of all the bones in this region. From the extreme outer point of one antitrochanter to the corresponding point on the same process on the other side measures, on a right line, about 7.5 cm., while the length of the "pelvic sacrum" is about 12 cm.

Thus, though steganopodous in character, this pelvis of *Pelecanus* differs materially in form and aspect from the pelvis of either a Cormorant or an *Anhinga*.

In the skeleton of the tail we find six free caudal vertebræ and a large pygostyle. All are highly pneumatic. The neural canal, of some considerable size, passes through the entire series and well into the pygostyle — an unusual occurrence in birds. All possess tuberous neural spines, but only the last three have hæmal ones, and these increase in size from the last caudal to include the fourth. They extend almost directly forwards. The transverse processes of the first five vertebræ are bent ventral-wise, more particularly in the second and third, while in the last one they are nearly aborted. The articular facets on the centra are concaved anteriorly, and nearly flat on the posterior aspects.

The large *pygostyle* is drawn out into a blunt point at its postero-superior angle. Its dorsal margin and the hinder half or more of its ventral margin are sharp — the remainder of the latter being thickened. The antero-inferior angle projects forwards, corresponding to the hæmal spine of the first vertebra absorbed to form this compounded bone.

Thus it will be seen that in this species of Pelican we have 41 vertebræ in its spinal column, namely: sixteen cervicals that are without free ribs; one cervical with

well-developed ribs; one free dorsal; three dorsals fused with the pelvic sacrum; fourteen in the pelvic sacrum; and six caudals; the pygostyle not being included in this count.

The *sternum* and os furcula are intimately fused together at the carinal angle, forming there an extensive union. This is also the case in *Pelecanus sharpei* (Pl. XXVIII., Fig. 42). Apart from this fact, the sternum has much about it to remind us of that bone in *Phalacrocorax.* It is profoundly concave upon its dorsal aspect, and correspondingly convex upon the opposite surface. Either costal border, transversely very broad, is occupied nearly its entire length by the five hæmapophysial facets, with the long, shallow concavities that are between them. These latter are riddled with small pneumatic foramina, while only a few of these openings are found elsewhere in the sternum, and they are very minute. Two wide, shallow indenta tions mark the xiphoidal margin, and the lateral xiphoidal processes are short with rounded ends. They extend backwards and outwards. The deep keel projects somewhat forwards, but is merged upon the surface of the bone behind long before it reaches the posterior sternal margin.

Each "costal process" is low and of a subquadrilateral outline. On the anterior border of the bone there is a notable concavity, longitudinally disposed and of some considerable breadth. It extends from the upper termination of the anterior and rather sharp margin of the keel to lead into the general concavity of the dorsal aspect of the sternal body. It separates the long, narrow costal grooves in front, as well as the rather deep costal facets above them.

U-shaped in pattern, the lower loop of the *os furcula* is not particularly stout, while the chief feature of this bone is its enormously swelled and enlarged free upper extremities (Pl. XXVIII., Fig. 42).

These are entirely hollow, and each is provided with an elongated pneumatic foramen upon its postero-mesial aspect. Postero-laterally, either one presents for examination a subcircular facet for articulation with the head of the corresponding coracoid, internal to which a stumpy, tuberous projection extends backwards. But this fails by an extensive interval to meet the scapula, when the bones of the shoulder-girdle are articulated as in life. The mesial and outer aspects of these great clavicular heads are flat and smooth; anteriorly, their thickened borders are convex from above downwards, the posterior borders being concave. On top they each present a flat, triangular surface with the apex to the front.

From its extreme pneumaticity I find a *coracoid* in *Pelecanus fuscus* to be a very light bone, while it has an altitude of 9.7 cm., being large in its other proportions. The sternal end is considerably dilated, and to the other side is a very small up-

turned epicoracoidal process. On the posterior side at the mesial angle there is a prominent jutting flange bearing an articular facet upon its entire under surface for articulation with the sternum. The inner two thirds of the inferior border is also for articulation with the same bone. The head is more or less massive, being obliquely compressed above. Well below this, anteriorly, is a non-elevated, circular facet for the os furcula. Above the large glenoid concavity, between it and the summit of the bone, is a deep valley passing downwards and forwards from the posterior aspect. Pneumatic foramina occur in it, as they do also on the mesial aspect of the shaft in an elongated group below the coracoidal head. The facet for the articulation with the scapula is a deep circumscribed concavity, and in front of it a conspicuous scapular process is developed, but it never reaches the os furcula in articulation when the bones are *in situ.* Below the open valley for the tendons, the shaft, is pierced by a foramen, a character often seen in birds of other groups.

A *scapula* is small in proportion for the size of the bird, thick, narrow and short. It is bent neither right nor left, but moderately curved, its convexity being along its dorsal aspect. It has a distinct ellipsoidal raised facet for articulation with the above-described pit in the coracoid, while the surface it offers for the glenoid cavity is small. Its most striking character is the very much elongated process at its antero-mesial angle. This acromial process does not meet the clavicle in articulation. On the dorsal aspect of the blade, near its middle, is a distinct tubercle for muscular attachment, that is quite noticeable.

Of the Appendicular Skeleton.

(See Plate XXVII., Figs. 31–34, 38 and 39.)

In the *pectoral limb* the *humerus* is a very long, large bone showing the usual double sigmoidal curvature in its shaft, which for its middle third is subcylindrical in form. (See Pl. XXVII., Fig. 34.)

The radial crest is but moderately developed, while a peculiar tuberous enlargement is found on the ulnar border of the bone, just distad to the pneumatic cavity. It is stopped abruptly immediately before we come to the shaft, by a distinct though very narrow notch. The ulnar tuberosity is not very prominent, only partially overhanging the pneumatic fossa. Between it and the true humeral head is a distinct notch or valley. At the distal end of the shaft, the oblique and radial tubercles stand out with considerable prominence; the olecranon fossa is pretty well marked, otherwise we find only the usual ornithic characters here. The humerus has an extreme length of about 27 centimeters.

The ulna of the forearm is even much longer than this, being fully 32.5 centimeters in length, and from its great pneumaticity a very light bone. At its proximal extremity it has a very large pneumatic fossa just below the facet for articulation with the radius. The olecranon process is barely at all developed. Along the moderately curved shaft there are at least twenty-two distinct papillæ, nearly equidistant from each other, for the insertion of the quill-butts of the secondary feathers of the wing. On section, at its middle third, the shaft is triangular, and its distal end presents us with nothing peculiar. (The ulna of *P. sharpei* is shown in Pl. XXVII., Fig. 31.)

The *radius* is a long, slender bone and is also somewhat curved. Its distal end is transversely expanded, below, which expansion is the pneumatic fossa.

The *radiale* and *ulnare* of the *carpus* both plainly show the pneumatic fossa leading into them, as do all the bones of the manus. The *carpo-metacarpus* has an extreme length of about 12.4 centimeters. Along its continuity it is slightly carved anconad, while the very slender medius metacarpal stands well away from the main shaft, being somewhat longer than it is at the point of anchylosis distally. The pollex metacarpal is short and bulky. The carpo-metacarpus of *P. sharpei* exhibits the usual characters of this bone among the Pelicans (Pl. XXVII., Fig. 39).

The proximal phalanx of the index digit, with a length of 5 centimeters has a broad expansion posteriorly, and is peculiar in being perfectly flat and smooth upon its anconal side, while upon the palmar aspect it is divided into two deep concavities which are absolutely riddled with pneumatic foramina at their bases.

The terminal joint of this finger is long and trihedral in form, with its pneumatic foramen at the proximal end. Though a little longer than the pollex phalanx, the latter has very much the same shape, and is likewise pneumatic. The free terminal joint of the medius digit has a broadish, triangular expansion behind, and the holes for the admission of air pierce it upon both sides. This bone is 3.4 centimeters long, by 1.3 broad at its broadest part; while the distal joint of index has an extreme length of 4.6 centimeters.

In the *pelvic limb*, a *femur* although pneumatic to a certain degree, it is not so markedly so, as either the tibio-tarsus or the tarso-metatarsus. It will, in the dried skeleton, probably weigh more than the former, notwithstanding it is not as large, nor so long. Its stout shaft is but very little bowed in the antero-posterior direction, and the extremities are large and massive. The broad trochanter does not rise above the articular summit of the bone proximally, and the pit for the round ligament on

the caput femoris is but little excavated. Distally, the condyles appear to be somewhat antero-posteriorly compressed, and transversely spread apart from each other. The external condyle is slightly the lower and larger of the two, and it is deeply cleft behind for the head of the fibula. Anteriorly, the rotular channel is shallow, nor is the popliteal fossa on the other side of the bone as deep in proportion as we find it in many other birds, both large and small, (Pl. XXVII., Fig. 32).

A *tibio-tarsus* instead of being bowed in the antero-posterior direction as it often is, it curves the other way so that the fibular border of the bone is convexed, and the opposite one, correspondingly, or even rather more, concaved. The extremities are large, but the several cnemial processes at the proximal one are but very moderately developed. Low and long, the fibular ridge extends down half the length of the shaft, and its articular margin or border is roughened. The tibio-tarsus of *P. sharpei* exhibits these characters very well, as they are seen in the *Pelecanidæ* generally (Pl. XXVII., Fig. 33).

At the distal end of the *tibio-tarsus*, the large condyles of the usual reniform outline, protrude prominently to the front, while behind they almost immediately merge into the general surface of the lower end of the shaft. The intercondylar interval is deeply excavated between them in front; at their lateral aspects the points for tendinal and ligamentous insertion are roughened and distinctly defined. A small bony bridge, such a frequent ornithic character, spans obliquely the anterior, longitudinal channel for the passage of tendons. In the deepest part of this recess, and directly under this little osseous bridge, a large pneumatic foramen enters the shaft of the bone. It is the principal aperture of this kind, by far, in the bone, and exists in the same place in the shaft of the fellow of the opposite side.

A *fibula* has its head and articular surface thereon moderately well developed, but the bone contracts rapidly as we proceed in the direction of its distal end, and after passing the articular surface for the tibia, it comes to be little more than a stout, bony thread, that by no means reaches the condyle of the tibio-tarsus, nor does it anchylose with its distal end.

Pelicans have, comparatively speaking, a very small *patella*, which is roughly wedge-shaped in form, with the flat base below, and the superior edge rounded, and not especially sharp.

The *tarso-metatarsus* is a stout, straight bone, with pronounced characteristics. The intercondyloid process upon its summit is rounded and conspicuous. Immediately below it, in front, terminates the usual longitudinal channel found on the anterior aspect of the shaft. It is deep here and opens into the shaft by a double pneu-

matic foramen. The inner one of these is large, and not only communicates with the interior of the shaft but passes also directly through it—appearing to the inner side of the base of the hypotarsus as a large foramen. Two or three much smaller foramina appear upon the opposite side of the hypotarsus, and they lead to similar passages through the shaft.

A prominent feature of this bone is its large hypotarsal process. This is composed of a thick, oblong piece or internal portion, which is capped upon its posterior aspect by an elliptical, vertical cap, having slightly protruding margins.

Two very much smaller such plates are developed external to this larger one, having each only about one half its altitude, and being not more than one fourth as thick. By their posterior surfaces more or less ossifying across, two vertical tubes are formed, an internal and external one, through which the tendons pass in life. As thus formed, this hypotarsus stands out rather abruptly and perpendicularly from the shaft, with hardly any inclination to merge with it at its lower part, as is the case in a good many birds. As to the shaft of this bone, it is convex posteriorly and strongly marked by the raised muscular lines; it is concaved slightly in front, the excavation being very deep proximally; shallow in the middle third; and deepening a little again as it passes into the usual foramen between and above the external and middle trochlear processes. These latter are large and normally disposed, the mid one being the lower of the three, while the internal and external project about equally backwards. The facet for the free first metatarsal is concave and of some considerable size. The *os metatarsale accessorium* is a little over two centimeters long, presenting the usual head and being slightly twisted upon itself distad. It agrees with the toe-joints in being non-pneumatic. These latter are nearly all straight, only some of the distal ones being slightly curved. For a bird as large as a Pelican they indicate rather a feeble foot, and this is further sustained when we come to see the weak terminal joints, which are transversely somewhat compressed, not very long, but withal distinctly, in fact rather strongly curved. These phalangeal joints are arranged upon the plan of 2, 3, 4, and 5 bones to the hallux, second, third and fourth toes respectively.

Pelecanus fuscus has a femur 8.5 cm. long; a tibio-tarsus of 12.5 cm.; a tarso-metatarsus of 7.8 cm. and a mid-anterior basal phalanx of pes of about 3.9 cm. in length.

When one comes to think of it then, a Pelican has rather a peculiarly balanced skeleton. Its lower jaw is considerably longer than its ulna, and the latter is in turn considerably longer than the humerus. This last-named bone is only a little more than half as long as the carpo-metacarpus of manus. The tibio-tarsus and the carpo-

metacarpus are almost exactly of a length, the difference being only a millimeter in favor of the former.[19]

Further information in regard to the osteology of the *Pelecanidæ* will be given later on in the present memoir, as well as in the explanation of plates at its close. In Volume I. of the *Hand-List of Birds* by Dr. R. Bondler Sharpe (1899, pp. 238, 239), I find that he recognizes ten species of existing Pelicans, and seven fossil ones. They are found in nearly all parts of the world, including Australia, Tasmania and New Guinea. It is not likely that they differ very widely in their osteology, and it is probable that in its main features it is very well exemplified in *Pelecanus fuscus* as has just been set forth above.

Existing Pelicans have by ornithologists generally, all been restricted to the one genus *Pelecanus* of the family *Pelecanidæ*, where they undoubtedly belong.

On the Skeleton of Fregata.

(See Plate XXIX., Figs. 45–48; Pl. XXX., Figs. 50, 51.)

Of all the steganopodous birds perhaps no one of them exceed *Fregata aquila*, in point of interest, in so far as its osteology is concerned. In not a few particulars it has a very remarkable skeleton, while in others it would appear to indicate that the form or species is a more or less generalized one. For example, both superficially and otherwise, the *skull* of *Fregata* resembles, in not a few respects, the skull in some species of Albatrosses (*Diomedeidæ*). This not only applies to the lower jaw, where the similarity is very evident, but also to a number of characters in the cranium and face. The long, powerfully hooked superior mandibles are a good deal alike, as are the maxillo-palatines. *Fregata* has a vomer that approaches that bone in the Albatrosses; its palatines are not far off, and even still less so its pterygoids and quadrates. The lacrymals are upon the same plan of structure, and the entire

[19] There are some specimens of embryos and subadults both of *Pelecanus* and Cormorants in the U. S. National Museum collections, and at my request Mr. Lucas has examined some of these for me, and writes the following letter on the subject, for all of which it gives me pleasure to thank him.

DEAR DR. SHUFELDT:

I have examined *Pelecanus* sp. about three or four days old and *Phalacrocorax carunculatus* for supramaxillary and found no trace in either. *Pelecanus* seems to mature more rapidly than *Phalacrocorax*. In the young Pelican the lacrymal is well developed and free, and there is no trace of the partial hinge joint at base of bill. There are traces of the three fused metatarsals and the calcaneum (?) is still free. In the young Cormorant the nostrils are still open, the lachrymal free. The occipital style is represented by ligament and were we all ignorant of its existence, it mght readily be overlooked. The hyoid is large. It would seem then that the supramaxillary does not appear until late in life and it may have no morphological meaning; simply it ossifies at the time of closing of nostrils. The occipital style of *P. carunculatus* is small in the adult. The specimen was about one third grown, and about ten days old probably.

Sincerely yours,

FREDERIC A. LUCAS.

cranium proper in the Man-o'-war-Bird might well answer for that of an Albatross but slightly removed from the typical stock. *Fregata*, however, lacks the deep supraorbital glandular fossæ so characteristic of the *Diomedeidæ*, and, from above downwards, the skull is somewhat more compressed than it is in, for example, such a species as the Short-tailed Albatross (*D. albatrus*) (Pl. XXIX., Fig. 46).

The superior mandible is broad at its base, and tapers gradually forwards, to be armed at the apex with a powerful and decurved hook which is exceedingly sharp at the point. This mandible is convex from side to side, moderately compressed, and concave longitudinally along the mid-line of the culmen, from the cranium to the base of the apical hook anteriorly. The narial apertures are small and situate each at the bottom of a fossa-like depression, while from them running directly forwards, one upon either side, is a distinct groove. It is rather deep, and very narrow, not being carried upon the hooked part of the bill at its distal termination.

No distinct cranio-facial hinge exists, but at the middle point in that region the proximal ends of the premaxillaries remain unobliterated throughout life (Pl. XXIX., Fig. 46).

Deeply concave towards each other, and with sharpened margins, the superior borders of the orbits are separated from each other by an interval of something more than 2 cm. Mesially, the intervening frontal surface shows a slight elevation, while in the parietal or post-frontal region there are two larger, convex and elongated elevations placed side by side with a median, not at all deep, depression passing between them. Within the cranial casket these elevations harbor the superior surfaces of the cerebral hemispheres, and the skull is thinner there than elsewhere (Pl. XXIX., Fig. 46).

The crotaphyte fossæ are well-defined, even better so than in an Albatross (*D. albatrus*), being very slightly depressed below the general surface, and, in the middle line posteriorly, do not meet by an interval of a centimeter (Pl. XXIX., Fig. 45).

Apart from this character, and the fact that the squamosal processes are more prominent and sharper in *Fregata*, the posterior aspect of its cranium agrees almost exactly, character for character, with what is presented to us on that view in the cranium of *D. albatrus*. In this I do not exclude the pterygoids and quadrates.

The large subvertical, subcylindrical foramen magnum is partially overarched by the well-defined occipital area, and the condyle, although of the same shape, is not quite as prominent as it is in an Albatross (Pl. XXIX., Fig. 48).

Seen upon side view, we are to note the deep valley of the temporal fossa, made so by the large outstanding post-frontal process anteriorly and the sharp, ridge-like squamosal projection referred to above (Pl. XXIX., Fig. 45).

The *lacrymal* is a free bone articulating by its upper portion with the free border formed by the frontal and nasal bones, while its descending limb is bulbous at its lower extremity, and fails to reach quite the maxillary below it. The pars plana is nearly aborted, there being merely a small bridge of bone left, that arches over the anterior end of the nasal nerve as it enters the rhinal chamber. This nerve passes in an open groove, but is again shielded by an osseous span, just as it enters the orbit. The "foramen rotundum" is large and is distinct from a still more extensive vacuity which is seen above it on the anterior wall of the cranial casket. No foramina exist in the interorbital septum proper. Occasionally a small distinct nerve foramen is seen to the outer side of the opening for the exit of the optic nerve. The anterior border of the mesethmoid is both concaved and sharpened (Pl. XXIX., Fig. 45).

The zygomatic bar is quite straight, being transversely compressed at its quadrato-jugal end, to become twisted upon itself in the jugal part, and so vertically flattened for the remainder of its extent or in the maxillary moiety. The extreme anterior end fuses in between the premaxillary and nasal. At the hinder extremity we find the usual little peg articulating in the pitlet on the outstanding process of the quadrate (Pl. XXIX., Figs. 45 and 48).

As has already been remarked above, one of these last-named bones bears a very close resemblance to the quadrate in an albatross. The orbital process of the *os quadratum* in *Fregata* is antero-posteriorly compressed just as it is in *Diomedea,* and its free extremity is expanded and finished off in the same manner.

We notice a slight difference, however, in the form of the internal articular facet of the mandibular end of the bone. It is more compressed from before, backwards in *Fregata,* and the articular surface presents but one common convexity, whereas in *Diomedea* this facet is impressed by a deep, oblique valley, the axis of which is parallel to the pterygoid of the same side.

As in the Albatross, a *pterygoid* bone is a straight, stout element, with somewhat enlarged anterior end, and a markedly expanded posterior one; in the last character being much more enlarged than it is in *Diomedea.* Both birds have their pterygoids pneumatic, and when articulated *in situ,* they touch each other in the middle line, beneath the sphenoidal rostrum.

In *Fregata* the basitemporal region is small and of a triangular outline; the eustachian passages are very open canals, and their anterior beginnings are separated by quite an interval — the base of the sphenoid standing distinctly between them (Pl. XXIX., Fig. 48).

Although morphologically very much alike, the *palatines* in *Fregata* fuse together where they come in contact with each other posteriorly, which is not the case in any Albatross ever examined by me. The ascending and descending laminæ are not so powerfully developed as they are in the Albatrosses, but in *Fregata* we still find the broad, horizontally flattened anterior moieties of the palatines, with the mesial, elongated and narrow interval separating them. At the fore part of this we likewise see the *maxillo-palatines*, similarly separated, with their *external* borders and surfaces accurately fused with the contiguous bones. Between them, we discover the sharp apex of the extremely slender, and long, and free, and curved *vomer* of the Man-o'-war Bird, so very suggestive of being an extreme modification of that element as we found it to exist in *Diomedea.* (See Figs. 16 and 17, in my memoir on the Osteology of the Tubinares and Steganopodes, P. U. S. N. M., 1888, p. 279, for the vomer in an Albatross.)

The postero-external angle of a palatine in *Fregata* is inclined to be somewhat produced, whereas in the *Diomedeidæ* as a rule that angle is rounded off (Pl. XXIX., Fig. 48).

Upon examining the *mandible* in *Fregata* it also presents a number of characters it has in common with that bone in *Diomedea.* In form it is a long V-shaped structure, with truncated postero-articular ends. The rami are strong and thick; the ramal vacuities are closed in; the rather meager symphysis is decurved and sharply pointed at the apex. Along the superior margin of either dentary portion, runs a distinct groove; these borders being cultrate in the Albatross, and the aforesaid groove being conducted down upon the mesial aspect of the dentary element, where it is far less pronounced, and its nature not so marked. The mesial aspect of either dentary part of the jaw in *Fregata* is also *deeply* grooved for nearly its entire length; this last groove is but faintly developed in *Diomedea,* and that only at the anterior third of the bone (Pl. XXIX., Fig. 47).

Fregata has a more pneumatic mandible than *Diomedea,* and the foramen at either articular end is, in the former genus on top of the mesial process, while in the latter it is situated at the *base* of the obliquely-disposed, deep, central concavity, or, in other words, that concavity which is intended to accommodate the inner large articular facette on the quadrate. It is single and circular in either case.

Fregata has a very simple skeleton as to its *hyoidean apparatus,* for the fore part is considerably aborted, while behind all the elements do not ossify. The small glossohyal is performed entirely in elementary cartilage, and only the diminutive ceratohyals, which are distinct from each other, ossify. The short, rather bulky, first basibranchial ossifies, but there is no sign of a second one. Of the thyrohyal ele-

ments, the ceratobranchials are long, slightly curved, and completely ossified; the epibranchials are in cartilage only. In my specimen the *sclerotals* of the eye, and the bony elements of the internal ear, are missing.

Of the Remainder of the Axial Skeleton.

Upon examining the vertebral chain of *Fregata aquila* we find in it thirteen vertebræ in the cervical region, that do not support free ribs; the fourteenth vertebra has a long, slender pair that are without unciform processes, the next five, all freely movable upon each other, connect with the sternum by means of their costal ribs or hæmapophyses; then, finally, there are two pairs of pelvic ribs, but it is only the costal ribs of the leading or anterior pair, that connect with the sternum. In the specimen before us, we may call them, from the fifteenth to the nineteenth vertebra inclusive, true dorsals, while counting, as best we may, the number of vertebræ fused together in the pelvic sacrum, there appear to be fourteen in all. Next follow six free caudals and a large pygostyle.

Since the first part of this memoir was written I have had placed before me, a skeleton in the rough of the Great Wandering Albatross (*D. exulans*), and upon comparing the arrangement and number of its vertebræ with what has just been given for *Fregata,* we find it to be dissimilar in many particulars. This leads me to think that with respect to the spinal column, the ribs, and the vertebræ, no *typical* Albatross will be found to agree with the Man-o'-War Bird.

Pneumaticity is a prominent character of the trunk skeleton of *Fregata,* and it would seem that all the bones enjoyed that state. The *atlas* has a broad neural arch, and its cup instead of being perforated, is extensively notched above. On the *axis* the "odontoid process" is short and stumpy; and its hæmal spine is also an insignificant affair. On the dorsal aspect of this vertebra, the neural spine is broad and tuberous, while the postzygapophysial processes are much swollen also. These latter, in the third vertebra, are joined upon either side with the prezygapophyses by means of a somewhat delicate interzygapophysial bar. A large hæmal spine is present here, and a low neural one. The same character is to be found in the fourth vertebra, and both third and fourth possess short backward-projecting parapophysial spines.

In the fourth or fifth cervical a distinct neural process exists; it is absent again to include the ninth vertebra; it is but faintly developed in the tenth, and from thence backward it gradually increases in proportion and changes in form, until we have the low, quadrate plate of the dorsal series. Throughout the latter, hæmal spines are absent, and from the fifth to the tenth vertebra inclusive, the carotid

canal exists, unclosed as it is by the rather feebly produced parapophyses. From the third vertebra to the thirteenth inclusive, lateral vertebral canals are to be found, and in the fourteenth vertebra the pleurapophysial elements free themselves as a pair of ribs. It is only in the last three dorsals that metapophysial spines, of no great length, extend backward from the postero-external angles of the transverse processes, and in these three vertebræ, upon their dorsal aspects, a pneumatic pit is found, on either side, posterior to the prezygayophyses. The mode of articulation among the centra is of the common ornithic character, and one of the chief features distinguishing these vertebræ is the lack of prominence, or even entire absence, of projecting processes, so conspicuous in many other birds. A good example of this is seen in the eighth, ninth, tenth and eleventh vertebræ, where the tendency of the short parapophysial processes is to merge with the centra by means of osseous bridges connecting the two; and another is the marked absence of hæmal spines.

As near as I can judge from my specimen, the arrangement of the ribs of *Fregata* is as follows: On the fourteenth vertebra there is a rudimentary pair, while on the fifteenth there is a long, slender pair of free ribs, that are without epipleural processes. These are well-developed on the succeeding pair belonging to the sixteenth vertebra; and this pair of ribs are the first of the series to connect with the sternum, by means of rather short hæmapophyses, the ribs of the dorsal series, seventeenth to nineteenth vertebræ inclusive, are long, very narrow, highly pneumatic, and are characterized by the unusual length of their epiplural spines. They all have costal pairs of ribs, gradually increasing in length, and connecting with the sternum.

Two pairs of pelvic ribs are seen, both lacking epipleural appendages, and the ultimate pair anchylosed with the vertebra to which they belong, and with the ventral surfaces of the ilia. The last pair of costal ribs fail to reach the sternum.

The *pelvis* is broad and flattened. Anteriorly one entire vertebra projects beyond the ilia, but it is coössified in its position with the "sacrum."

Viewed from above, we are to note that the ilia are widely separated from the sacral crista, which latter are very large, rounded and depressed. Slight concavity characterizes the preacetabular iliac areas, and the anterior emarginated borders of these bones are very obliquely truncated from their antero-mesial angles backwards. The interdiapophysial vacuities in the uro-sacral region are of considerable size, and the most part they have a parial arrangement and are very large in front.

The postacetabular areas are about equal in extent to the anterior ones, and are convexed as much as the latter are concaved. Bony fusion between the ilia and the vertebræ is, in all this region, very perfect, extending clear to the sacral extremity, and no part of the latter projects posteriorly beyond the iliac bones.

Upon lateral view of this pelvis we note that the ischium (upon either side) is much drawn out behind, and there pointed. It may be said that hardly any ilio-ischiadic notch exists, the usual site for it being very shallowly rounded off. For their anterior moieties the pubic styles are very slender, but their elongated posterior ends are more clubbed and thickened, where they come simply in contact with either ischium above them. On the lateral aspect the antitrochanter is seen to be not very prominent; and the cotyloid ring and ischiadic foramen have their usual ornithic characters. Posteriorly, the obturator foramen opens most completely into the space of the same name; thus, in reality, merging the two vacuities into one. In the capacious pelvic basin on the ventral aspect we find the last six parapophysial struts of the vertebræ, when present, very distinct and slender, being thrown up as braces in the usual manner. This feature also obtains with all the vertebræ at the fore part of the sacrum, and indeed, there are only two in the series that entirely lack this development of the parapophysial processes, they being the twenty-sixth and twenty-seventh of the vertebral chain as a whole.

FIG. 37. Dorsal aspect of the pelvis of *Fregata aquila*, very slightly reduced. From a photograph by the author of the specimen in the collection of the U. S. National Museum (No. 18485).

This pelvis is very light and highly pneumatic; air-holes always occurring in a small group immediately in front of either cotyloid ring, as well as in many other places.

Moreover, in many respects the pelvis in *Fregata* is a very differently characterized bone from what we find in an Albatross.

In the skeleton before me, I find *six* large, free *caudal vertebræ*, besides a big parallelogrammatic *pygostyle*. The vertebræ have very long, depressed, narrow diapophyses, the anterior and posterior borders of which are rounded off. Stumpy, bifid, centrally perforated hæmal spines are found only in the last two or three, while in all these vertebræ, so light from the high state of pneumaticity they enjoy, the neural spines are elevated and pointed. The neural canal, nowhere very large, seems to extend even into the pygostyle. This latter bone has a rounded superior border, while below and behind it is thickened and broadened. At its lower part

it is usually transversely perforated by an oval foramen of some size. Above its anterior concave articular facet the margin is sharp, the corresponding posterior one being rounded. In the more expanded part below this latter margin, we find the numerous pneumatic perforations that lead into its interior parts. The large pygostyle of an Albatross is triangular in outline, and the caudal vertebræ of one of these birds bear but slight resemblance to those bones in *Fregata.*

A number of anatomists in various places have already invited attention to the striking peculiarities of the *sternum* and *shoulder girdle* of the species we here have under consideration (Pl. XXX., Figs. 50 and 51).

In the specimen at hand, I find that the symphysis of the furcula is extensively coössified with the fore part of the carina of the sternum, while its upper clavicular extremities are in a like manner very completely fused with the mesial aspects of the summits of the coracoids, upon either side. The sternal ends of these latter bones form free articulations with the sternum, and the scapulæ are also freely articulated each with the corresponding coracoid. This description, it will be seen, differs from what Newton found in a specimen of *Fregata*, and he says, "In one very remarkable way the osteology of *Fregata* differs from that of all other birds known. The furcula coalesces firmly at its symphysis with the carina of the sternum, and also with the coracoids at the upper extremity of each of its rami, the anterior end of each coracoid coalescing also with the proximal end of the scapula. Thus the only articulation in the whole sternal apparatus are where the coracoids meet the sternum, and the consequence is a bony framework which would be perfectly rigid did not the flexibility of the rami of the furcula permit a limited amount of motion."[20]

My skeleton is from an adult bird, as no doubt the one examined by Professor Newton was, and this makes the circumstance all the more remarkable.

In Albatrosses the symphysis of the furcula also fuses with the sternum, while the sternum, coracoid, and scapulæ of some of those birds bear other slight resemblances to the corresponding bones in the skeleton of the Man-o'-war Bird.

Fregata has a very short sternum, being about as long as it is broad. The body above is profoundly concaved, where it shows numerous pneumatic foramina especially down the median portion. Either costal process is triangular, pointed and lofty, and the costal borders short. They about equal in length, however, on either side, the sharp-edged lateral margin.

The rather short xiphoidal processes are situated, one at either posterior-external angle of the body of the bone, and they are rounded off behind. For the rest, the xiphoidal border that joins them is nearly an unbroken transverse line, exhibiting

[20] Alfred Newton, "Dictionary of Birds," Art. Frigate-Bird, Part I., pp. 293, 294, London, 1893.

neither notches or indentations. Ventrally, the carina extends the entire length of the bone, its lower margin being very convex and thickened ; the lateral edges of the latter extending beyond the sides. The anterior carinal boundary is sharp and short surmounted above by a rudimentary manubrium. Either costal groove is deep and wide, and the coracoids, when articulated *in situ,* meet in the median line above, where they separate the anterior sternal border and the small trihedral manubrial process.

The os furcula is of the U-shaped pattern, and is coössified, as has been said, with the sternum and coracoid. Its rami are narrow and compressed, with its hypocleidial portion below very broad, triangular in outline, slightly concaved in front, and withal antero-posteriorly compressed. Above, the clavicular ends are transversely very thin. Either one shows two places of bony fusion ; one at the tip, and a still more extensive one in front of the head of the coracoid. Mesiad, between these, there exists an oval foramen. The clavicular extremities are separated from each other by a distance of 6 centimeters. By far the largest bone of the pectoral girdle is the *coracoid.* Either one of them has a height of 8.5 cm. with a large shaft and broad sternal end. A minute epicoracoidal process is present, and the clavicular process, although pretty well developed and curving forwards, does not reach the end of the clavicle by quite an interval. The glenoid cavity faces more than usual to the rear, much as it does in an Albatross. Measuring on its chord, a scapula has a length of about 8 centimeters. Its inner border is convex, and its outer more decidedly concave. For its middle third, the bone is narrow and thickened, the distal extremity being slightly dilated, compressed from above downwards, and brought to a rounded point posteriorly. Its coracoidal extremity is also much compressed in the vertical direction, very wide from side to side, with its inner angle drawn out into a well-developed process, and with a small glenoidal facet occupying the other one.

The Pectoral Limb.—The bones making up the skeleton of the upper extremity are all completely pneumatic, and, as compared with those of the pelvic limb, are chiefly remarkable for their enormous comparative lengths. This is well shown in the following table :

Length of	Humerus	21.0 cm.
"	Femur	5.7 "
"	Ulna	27.5 "
"	Tibio-tarsus	7.5 "
"	Radius	26.6 "
"	Fibula	6.5 "
"	Carpo-metacarpus	13.0 "
"	Tarso-metatarsus	2.4 "
"	Index digit	12.5 "
"	Mid-anterior toe	7.6 "

The *humerus* presents the usual double sigmoidal curve seen in the humeri of almost all birds. Its shaft is smooth and subcylindrical in form, being somewhat compressed from side to side. The pneumatic fossa is inclined to be shallow and the foramina in it very small; but there are pneumatic openings in other parts of the bone, notably at the distal extremity, where large ones occur upon either aspect. The radial crest or the crista superior is very prominent, being of a triangular outline, with a thickened border distad. The ulnar tuberosity or the crista inferior is also conspicuously developed, with the tuberculum internum much produced. The caput humeri is elongated and spindleform; it is separated from a flat tuberous area on the ulnar side of the palmar aspect by a deep transverse sulcus, the sulcus transversus. At the distal end of the bone the muscular grooves are very deep on its anconal aspect, the ulnar side apparently much raised in consequence. A deep fossa exists both palmad and anconad to the trochleæ. A low ectepicondylar eminence is present, with deep, circumscribed muscular pits near it on the radial border. No very special resemblance exists between this bone in *Fregata* and the humerus as it is found in any of the typical Albatrosses. The same would seem to apply to the remainder of the skeleton of this limb.

In the *ulna* we find the shaft somewhat more cylindrical than it is in the humerus, and presenting but a very slight degree of curvature. It has two distinct rows of papillæ for the quill-butts of the secondary feathers, the more prominent row being represented by eighteen of them. The concavities for the trochleæ of the humerus are deep with raised edges, but the olecranon process is low and tuberous. Its distal ends present the usual ornithic characters, with muscle-grooves very distinctly marked.

The *radius* viewed upon its superior aspect presents for its length an elongated sigmoidal curve. This curve for its distal two thirds nearly agrees with the curvature of the shaft of the ulna, when the bones are articulated *in situ;* while for the proximal third it is reversed, and here occurs a long, narrow, spindle-shaped "interosseous space." The radial shaft is more or less cylindrical, smooth, and but faintly marked by muscular lines or ridges. The distal end of the bone is considerably expanded in the transverse direction, and here pneumatic foramina are to be seen. Its proximal head is only moderately developed, and it is the middle third of the continuity of the shaft that possesses the greatest caliber. This latter very gradually diminishes as we approach the extremities.

Fregata when adult has in its wrist the two usual carpal segments, which, from the high state of pneumaticity they enjoy, are extremely light. Although they have the usual form seen in birds, they are here powerfully marked by the various muscular-grooves and articular facets that characterize them.

The *carpometacarpus* also presents us with the common ornithic features; though from its great pneumaticity, it is one of the lightest bones of its size we have ever met with in the class. The pollex metacarpal forms a large triangular projection at its usual site, while the shafts of the index and medius are nearly straight and parallel with each other; the former being fully six times the bulk of the latter. Distally, neither one projects beyond the other, as is sometimes the case in birds of other groups.

The expanded portion of the proximal phalanx of the index digit is both perforated and riddled with pneumatic foramina of various sizes and shapes, and upon both sides. This part sends down a conspicuous rounded process beyond the proper shaft of the bone, while from the antero-distal aspect of the shaft itself, a similar process projects forward. At the proximal extremity are two other apophyses standing out from the bone, one being upon its anconal and the other upon its palmar side, while the plane of the articular surface of the summit extends, to some extent, over and upon each. The distal or terminal phalanx of this finger is of great length; trihedral in form; and much scooped out posteriorly. Pneumatic foramina enter it at various points, one, somewhat elongated, even occurring at its apex. The pollex digit is not more than two thirds the length of the one just described, and its posterior aspect, instead of being scooped out, is very sharp and prominent; and this border in the still smaller phalanx of the medius digit, has upon it a low tuberous apophysis for muscular attachment. None of these terminal joints of the fingers appears to bear claws at their extremities.

The Pelvic Limb.—Feebleness of a very marked character stamps every bone of the lower extremity in *Fregata.* The skeleton here is, moreover, largely non-pneumatic. It is, apparently, only the femur and proximal moiety of the tibio-tarsus that enjoys that state at all. The former bone is quite as pneumatic as the humerus of the arm, while the portion of the tibio-tarsus mentioned appears to be only moderately so.

The *femur* is short and bulky, with its head very distinctly sessile, and its upper part markedly scooped out for the insertion of the round ligament. The trochanterian ridge does not rise above the articular summit of the shaft, and it is broad and flat in the antero-posterior direction externally. Below these parts extends the short, straight, cylindrical shaft, more or less strongly marked by the usual muscular lines. The condylar portion or distal end is weakly developed, though all the characters common to the femora of most birds are present. A fibular notch is well defined, and the external condyle is placed lower down on the shaft. Both the popliteal fossa and rotular channel are very shallow; the latter, it may be said,

hardly exists at all. Pneumatic foramina are always found at the base of the former, immediately above the internal condyle.

Lack of salient characters distinguishes the *tibio-tarsus* even more profoundly than the femur. Its cnemial crest and processes are almost completely reduced, the former barely rising above the nearly level articular summit of the bone. Comparatively short and quite straight, its shaft is of decidedly slender bulk, being subcylindrical in form. The fibular ridge is confined completely within the limits of its upper third, being but a little more than a centimeter in length. Its articulation with that bone is very free. At the distal end we find a pretty well developed pair of condyles, but the osseous bridgelet in front is low down and weak, indicating that the tendons too, which it is intended to hold in place, must also be but feebly developed.

The *fibula* is nearly complete, its lower end, of hair-like dimensions, is fused with the side of the shaft of the tibio-tarsus immediately above the external condyle of the latter bone. Above its proximal articulation, the fibula is of larger size, standing in strong contrast with the very slender straight part below that point.

Fregata has a flake-like *patella* of some size, being quadrilateral in outline, and marked obliquely across its anterior surface by a groove for the ambiens muscle. As with the vast majority of birds, it is non-pneumatic in character.

The tarso-metatarsus is wonderfully short and thick-set. This bone is so much abbreviated in the direction of its longitudinal axis that it hardly appears to possess any shaft at all. Antero-posteriorly it is flattened, while transversely it is relatively broad. On its anterior surface well-marked grooves plainly indicate the three metatarsal elements of which it is composed, while posteriorly the short shaft is quite flat and smooth. Its hypotarsus is bulky and circumscribed, — not extending down the bone, — while a single central canal pierces it for the passage of the tendons. This is of some size. Distally, the trochlear processes are comparatively large and spreading. They all lie in nearly the same transverse plane, the inner one being the lowest in position; the outer, the highest; and the middle one occupying an intermediate place. The foramen for the passage of the anterior tibial artery is peculiar, inasmuch as its lower exit is in the sulcus between the outer and middle trochlear projections instead of on the back of the shaft above that point, where it is usually to be found. The accessory or first metatarsal is as large in proportion as in those birds where the skeleton of this limb is harmoniously developed in point of size with the rest of the osseous system. All the phalangeal joints of the pes are well developed, being arranged upon the plan of 2, 3, 4, 5, for the first to fourth toe respectively, and were not this part of the skeleton of the foot

ridiculously small for the size of the bird to which it belongs, it might, with truth, be said to be very well developed.

The ungual joints are powerfully curved, and considerable curvature characterizes the majority of the others, especially those of the first, second, and third toes. Although a digression from the consideration of the osteology of *Fregata*, it is interesting to note that the greatly developed podotheca of the ungual joint of the middle toe is beautifully pectinated, — a fact, in the present instance at least, that distinctly militates against the view, still entertained by a few ornithologists, that the function of the toes of birds so armed is the possession of an instrument wherewith they may rid themselves and their plumage of vermin.

Relationships of the Steganopodes.

If we base our judgment on the osteology of the birds that have been examined in the present memoir, it would seem that we are justified in regarding the Suborder STEGANOPODES as being composed of three superfamilies. These may be designated as, first, the *Pelecanoidea;* second, the *Phaëthontoidea;* and third, and lastly, the *Fregatoidea.*

Arranging these, and arraying the existing families of them, with their genera, a taxonomic scheme on such a basis would stand thus:

SUPERFAMILIES.	FAMILIES.	GENERA.
Pelecanoidea	Pelecanidæ.	Pelecanus.
	Phalacrocoracidæ	Phalacrocorax. Nannopterum.
	Anhingidæ.	Anhinga.
	Sulidæ.	Sula.
Phaëthontoidea.	Phaëthontidæ.	Phaëthon.
Fregatoidea.	Fregatidæ.	Fregata.

The genera and families of fossil forms are not taken into consideration in this scheme.

Ornithotomists are agreed that the *Steganopodes,* constitute a well-defined group, but beyond this the majority are reticent as to the question of the affinities existing among the families and genera making up this group, and the relations of it as a whole to other avian groups in the system.

If from among the *Phalacrocoracidæ* we select the genus *Phalacrocorax,* there is no doubt, in so far as its osteology indicates, that it is closely related to the genus *Anhinga.* This, as has been shown above, is evident from a direct comparison of

the corresponding bones of the skeleton of any species of Cormorant with those of the skeleton of *Anhinga*.

On the other hand, and by similar methods, there is no disguising the kinship existing between *Phalacrocorax* and *Sula*, although the gap between these genera is somewhat greater than the one standing between the Cormorants and the Anhingas.

Pelicans of the genus *Pelicanus* are aberrant forms which, as osteologically indicated, have varying relations with all three genera thus far mentioned. They are however, apparently more nearly related to *Sulidæ* than they are to the Cormorants.

From the *Pelecanoidea* the passage to the *Phaëthontoidea* is not far to seek, for upon comparing the corresponding bones in the skeleton of such a Gannet as *Sula brewsteri* with those of *Phaëthon flavirostris* we are at once confronted with so many points of similarity as to leave no doubt in our minds that it is between the genera and families represented by such species as these that the linking of the two groups takes place.

This is important, for in another direction we are led, on the one hand, through *Phaëthon* to the suborder LONGIPENNES, and on the other to the suborder TUBINARES; *Phaëthon flavirostris* having some osteological characters that strongly suggest larine affinities, and still more that bring to mind the skeleton of a *Puffinus*.

Their distinct maxillo-palatines, their perforate nostrils, their hardly coalesced palatines, their four-notcheds ternum, and their ilia widely separated from the "sacral crista," taken in connection with numerous other important skeletal characters, fully entitle the Tropic Birds to rank as a superfamily — the PHAËTHONTOIDEA as given above.

There can be no doubt about *Fregata*, for the skeletal characters seen in its skull, its sternum and shoulder-girdle, its pelvis and limbs, and in its trunk skeleton, as we have in detail described them above, stamp it at once, not only as being a form having many skeletal characters completely at variance with those found in average steganopodous birds, as Cormorants and Gannets, but as a type likewise for which a superfamily must be created, in order to show that these striking departures are fully appreciated by the student of its osteology. As indicated in our scheme above, this superfamily may be designated as the FREGATOIDEA.

The pelvis in *Fregata* is decidedly more like the pelvis in *Phaëthon* than in other Steganopodes. In its pelvic limb-bones, which are extraordinarily short and otherwise weak, as compared with the very lengthy pectoral ones, and the size of the rest of the bird, it stands quite unique in the suborder to which it belongs. More remarkable than all, however, are the many characters in its skull, which powerfully recall the Albatrosses among the TUBINARES. These are so evident that one is almost

led to believe, if it be not actually the case, that the strong-hooked beak in the skull of *Fregata* is a diomedean character rather than a pelicanine one. Apart from the free ends of the furcula coalescing with the coracoids, there are characters in the sternum and shoulder-girdle of *Fregata* which also recall the forms of the corresponding bones in the Albatrosses, but beyond this there appears to be nothing else in the skeleton of the Man-o'-War Bird at all reminding us of those birds.

As this relationship exists between *Fregata* and *Diomedea*, remote as it may be, it nevertheless, taken in connection with what has been pointed out above in regard to *Phaëthon* and *Puffinus*, ought to lead us to believe that the Steganopodes are more closely affined with the Tubinares than they are with the Longipennes.

There are those who claim to see a kinship existing between the *Accipitres* and the Fregatoidea, but there are surely no indications of it in so far as the osteology of any of the representatives of the two suborders in question are concerned.

Addenda.

Since writing the above account of the osteology of the *Steganopodes*, I have personally reëxamined some of the material in the United States National Museum, and, thanks to the marked kindness of Mr. F. A. Lucas, the able Curator of the Department of Osteology of that institution, I have been permitted fully to examine and compare the entire collection there, constituting as it does the finest assortment of material illustrating the osteology of the *Steganopodes* in existence. A number of the specimens drawn from this material are now figured for the first time in the plates to the present memoir.

To what I have already set forth in the body of the paper, there is nothing I find in particular to add to the osteology of the *Phaëthontidæ* or the *Sulidæ*. Among the *Plotidæ* (the *Anhingidæ* of the A. O. U. "Check-List") I examined a skeleton of *Plotus levaillanti*, and it presents all the usual characteristics of the skeleton in that family of birds. A dorsal view of its pelvis is given in Plate I., Fig. 1, which will assist in illustrating what I have said in the body of the memoir in regard to the skeleton of *P. anhinga*. I have never had the opportunity to examine the skeletons of the two other known species of this family. (Sharpe's "Hand-List of Birds," p. 236.)

The collection of Cormorant skeletons (*Phalacrocoracidæ*) in the U. S. National Museum is, as I have said above, the finest in the world at the present writing, nearly every known species being represented. It is Mr. Lucas' intention, sometime in the future, I understand, to monograph this group, and it will be a very valuable contribution to the subject. Their skulls present some very interesting variations, and the majority of these are well shown in the figures of the Plates

illustrating this memoir (Plate IV., Figs. 13–21 and Plate VI., Figs. 25, 27 and 29). They not only vary in size according to the species, but perhaps the most interesting variation they offer is the marked vertical compression of the skull they exhibit, associated, as it is, with a decided elongation and narrowness of that part of the skeleton. This is well seen in such a species as *Phalacrocorax pelagicus robustus,* where this character about reaches its maximum. At the other extreme, we find the skull of some Cormorants to be moderately shortened, with a broad, dome-like cranium, which admits of an unusually capacious brain cavity. A species having this character markedly exemplified is *Phalacrocorax albiventris,* and its skull is shown in Plate IV., Figs. 14 and 21, and in Plate VI., Fig. 29. A good medium type standing between these two extremes is seen in *Phalacrocorax dilophus,* while all the other species of Cormorants tend either toward *P. p. robustus,* or toward *P. albiventris* in the matter of this flatness and elongate-narrowness of their skulls, or in the shorter, broader and more capacious cranium of the last-named species. The shading either way is often so gradual that everything else being equal, it hardly seems to offer justifiable grounds for generic divisions. Associated with these forms of the skull in the Cormorants, we are to note the variation in the form of the pterygoid bones at the inferior aspects of the same. Some *Phalacrocoracidæ* possess long and comparatively slender pterygoids, while other species have them much shorter and stouter. *Phalacrocorax p. robustus* is an excellent example of the first of these (Plate VI., Fig. 28), while *P. albiventris* well exhibits the last-named condition, while in *P. dilophus* again, they are moderately elongated and fairly stout, thus once more, affording an example of the medium type in this particular. In some Cormorants the mesethmoid bone is not perforated by a large median vacuity, as is seen to be the case in others. It is thus perforated in such species as *P. p. robustus* and *P. albiventris,* while it is perfectly solid in such forms as *P. dilophus* and *P. melanoleucus.* There are also interesting differences to be noted in the comparative size and form of the foramen magnum, the morphology of the cranio-facial hinge, and other minor points, the majority, of which, if of any importance, are noticed in the body of the present memoir.

The pelvis in the various species of the Cormorants also exhibits a difference in form. In *P. pelagicus,* for example, it is comparatively short, narrow, and with the ilio-ischiatic notch not very deep, while in *Graculus Carbo,* it is much elongated, narrow, and the aforesaid notch very deep. Other species of the *Phalacrocoracidæ* tend one way or the other in this particular. The short-bodied Cormorants have the sternum more or less broad and short, while in the long-bodied species this bone is likewise more elongated and narrower.

As I have shown in this memoir all Cormorants possess a big *patella*. Mr. Lucas in studying this bone has observed that this sesamoid in some of the species is perforated for the passage of the ambiens muscle, while in others it is not so, but this perforation is not associated with other characters in such a manner that the condition can be regarded as having any taxonomic value. Mr. Lucas at my request kindly examined this point for me in quite a number of species of Cormorants, and found that the patella is thus perforated for the ambiens in *Graculus Carbo, Phalacrocorax dilophus, P. vigua, P. harrisi, P. Magellanicus, P. albiventris,* (where it is small) and in *P. pelagicus,* while the patella is imperforate in *Phalacrocorax melanoleucus, P. punctatus, P. penicillatus* and *P. urile.*

Osteologically, the *Pelecanidæ* constitute quite a homogeneous group of birds, and certainly a thoroughly circumscribed family of the *Steganopodes.* I have examined the skeleton in several species, but more particularly in the case of *Pelecanus sharpei, P. fuscus, P. onocrotalus,* and *P. erythrorhynchus.* In some species the mandibles are broad and comparatively shorter than they are in others, and, when so, they are compressed from above downwards. This is the case in *P. sharpei* (Plate VII., Figs. 36, 37), and in this species we note in its skull that upon the lateral aspect of the superior mandible, just where it is joined to the maxillary bone, the compact tissue is continuous downwards to the anterior end of the corresponding palatine, completely overlying and concealing, on side view, the spongy tissue of bone in the rhinal chamber, (Fig. 37). Whereas in such a species as *P. fuscus* there is a large triangular interval left open here, so that upon the same view we are enabled to see almost the entire mass of the osseous spongy tissue of the aforesaid space, (see Fig. 40 of my memoir, "Observations upon the Osteology of the Order Tubinares and Steganopodes," Proc. U. S. Nat. Mus., 1888, p. 312). In the drawing referred to the upper and lower edges of the united palatines have been shaved off, but I was quite a juvenile osteologist when I prepared that specimen; indeed it was my first osteological preparation (1864). The correct form and outline of the lower united edge of the palatine bones is shown in the case of *P. sharpei* in Plate VII., Fig. 37, of the present memoir. In Figs. 35 and 40 of that plate I would say that the horny podotheca covering the superior mandible of *Pelecânus fuscus* has only in part been removed, and this also applies to the anterior two thirds of the mandible shown in Fig. 41. Beyond what has been mentioned above, in most other respects, the skulls of *P. fuscus* and *P. sharpei* are very much alike.

In the mandible the ramal symphysis is, for the size of the bone, altogether the weakest union of any in the entire Class *Aves.* For example, the ramus of the jaw in *P. sharpei* has a length of 34.5 centimeters, while the symphysis joining the two rami together, anteriorly, measures but 3 millimeters in any direction.

Explanation of Plates.

(All the specimens figured in the Plates (XXI.–XXX.) are reproductions of photographs made by the author, the material being in either his own private collection, or the collection of the United States National Museum.)

Plate XXI. Fig. 1. Dorsal aspect of the pelvis of *Plotus levaillanti*. Adult. (Coll. U. S. Nat. Museum No. 18,743.) Two of the pelvic ribs show upon the right side. Somewhat reduced; the mid-longitudinal line of this bone measures 9.5 cm. not including the ossified anterior tendinal extensions.

Fig. 2. Basal view of the skull of *Phaëthon æthereus*, adult, mandible removed, slightly reduced. Specimen in author's collection. From the island of San Pedro Martis, Gulf of California. Collected in April, 1889.

Fig. 3. Superior aspect of the skull of *Phaëthon flavirostris*, adult. (Coll. U. S. Nat. Musum No. 17,841.) Slightly reduced, the reduction being proportionate in amount with the skull shown in Fig. 2.

Fig. 4. Skeleton of left foot of *Fregata aquila*, adult. (Coll. U. S. Nat. Museum, No. 18,485.) Somewhat reduced. Sheath left on midanterior toe shows the " pectinated claw."

Fig. 5. Ventral view of the sternum of *Phaëthon æthereus*, adult (author's collection). Very slightly reduced. Collected in April, 1889. San Pedro Martis Isle, Gulf of California. The skull in Fig. 2 and this sternum are from two different individuals.

Fig. 6. Left lateral aspect of the trunk skeleton of *Phaëthon flavirostris*, adult. (Coll. U. S. Nat. Museum, No. 17,841.) Very slightly reduced. The skull shown in Fig. 2 belonged to this skeleton, but the reduction in the former is somewhat greater.

Plate XXII. Fig. 7. Right lateral view of the skull and mandible of *Sula gossi*, adult female (author's collection). Very slightly enlarged. Mandible detached. The superior mandible is tubular at the extremity and pervious at the apex. Collected at San Pedro Martis Island, Gulf of California, 16 Oct., 1888.

Fig. 8. Basal view of the skull of *Sula gossi*, adult female (author's collection). Very slightly reduced. Collected at same time and place as the specimen shown in Fig. 7.

Fig. 9. Basal view of the skull of *Sula Brewsteri*. Same specimen as shown in Fig. 7. Very slightly reduced. Left pterygoid bone dislocated inwards to show the form of the corresponding quadrate.

PLATE XXIII. Fig. 10. Superior aspect of the skull of *Sula gossi*. Mandible removed. Same specimen as the one shown in Plate II., Fig. 8. Very slightly reduced.

Fig. 11. Superior aspect of the skull of *Sula brewsteri*. Mandible removed. Same specimen as the one shown in Plate II., Fig. 9. Very slightly reduced, and in the same proportion as the skull shown in Fig. 10.

Fig. 12. Left lateral view of the trunk skeleton of *Sula gossi*. Reduced one third. Belonged to the same individual, which furnished the skull shown in Fig. 10.

PLATE XXIV. (All the bones figured in this plate are from the Coll. U. S. Nat. Mus. and their numbers are shown upon the specimens. They are all adult, and natural size.)

Fig. 13. Left lateral view of the skull of *Phalacrocorax pelagicus robustus*. Mandible removed. (See Fig. 18.)

Fig. 14. Left lateral view of the skull of *Phalacrocorax albiventris*. Mandible removed. (See Fig. 21.)

Fig. 15. Left lateral view of the skull of *Phalacrocorax urile*. Mandible removed. (Specimen bears no number.)

Fig. 16. Basal view of the skull of *Phalacrocorax melanoleucus*. Mandible removed (Australia). There is but one known species of cormorant in the world smaller than this one.

Fig. 17. Left lateral view of the skull and mandible of *Phalacrocorax dilophus*. Mandible detached. (See Fig. 19.)

Fig. 18. Superior aspect of the skull of *Phalacrocorax p. robustus*. Mandible removed. (See Fig. 13.)

Fig. 19. Superior aspect of the skull of *Phalacrocorax dilophus*. Mandible removed. (See Fig. 17.)

Fig. 20. Superior aspect of the skull of *Phalacrocorax melanoleucus*. Mandible removed. (See Fig. 16.)

Fig. 21. Superior aspect of the skull of *Phalacrocorax albiventris*. Mandible removed. (See Fig. 14.)

This series of specimens is designed to show the marked variation in form of the skull among the cormorants (*Phalacrocoracidæ*), ranging all the way from the much vertically compressed skull of *P. p. robustus* (Fig. 13) to the lofty skull of *P. albiventris* (Fig. 14).

PLATE XXV. Fig. 22. Dorsal view of the trunk skeleton of *Phalacrocorax urile*, with chain of cervical vertebræ naturally articulated but curved far backward and to the right. Reduced one half. The skull shown in Fig. 15 belonged to this skeleton.

Fig. 23. Left lateral view of the trunk skeleton of *Phalacrocorax urile*. Reduced one half, and the same specimen as shown in Fig. 22.

PLATE XXVI. Fig. 24. Anconal aspect of the right carpo-metacarpus of *Fregata aquila* (Specimen No. 18,485, Coll. U. S. Nat. Museum). Adult. Reduced; the actual extreme length of the bone being 13.2 cm.

Fig. 25. Left lateral view of the skull of *Phalacrocorax melanoleucus*. Mandible removed. Natural size. Same skull as shown in Plate IV., Fig. 20.

Fig. 26. Anconal aspect of the proximal phalanx of the medius digit of the manus of the right pectoral limb of *Fregata aquila*. Slightly reduced. From the same skeleton that the bone shown in Fig. 24 was obtained, with which it was distally articulated.

Fig. 27. Basal aspect of the skull of *Phalacrocorax dilophus*. Natural size. Same skull as the one shown in Fig. 17, Plate IV.

Fig. 28. Basal aspect of the skull of *Phalacrocorax p. robustus*. Natural size. Same skull as the one shown in Fig. 13, Plate IV.

Fig. 29. Basal aspect of the skull of *Phalacrocorax albiventris*. Natural size. Same skull as the one shown in Fig. 21, Plate IV. Note how much shorter the pterygoid bones are in this species as compared with the corresponding elements in the skulls shown in Figs. 27 and 28.

Fig. 30. Dorsal aspect of the sternum and os furcula of *Phalacrocorax albiventris* (No. 18,437, Coll. U. S. Nat. Museum). Reduced about one fifth. (See Fig. 21, Plate IV. Both from the same bird.)

PLATE XXVII. (*Pelecanus sharpei* and *Pelecanus fuscus*. Adults. All less than half natural size. *P. sharpei* is No. 18,736 of the Collection in the U. S. Nat. Museum, and *P. fuscus* (author's collection) was shot by me on Indian Cay, Bahama Banks, in 1864.)

Fig. 31. Anconal aspect, right ulna, *Pelecanus sharpei*.

Fig. 32. Anterior aspect, left femur, *P. sharpei*. Same specimen as Fig. 31 and the others on the Plate.

Fig. 33. Anterior aspect of the left tibio-tarsus, *P. sharpei*.

Fig. 34. Palmar aspect of left humerus, *P. sharpei*.

Fig. 35. Basal view of the skull of *P. fuscus*; mandible removed.

Fig. 36. Basal view of the skull of *P. sharpei*; mandible removed.

Fig. 37. Left lateral view of the skull of *P. sharpei*; mandible removed.

Fig. 38. Anterior aspect of the right coracoid; *P. sharpei*.

Fig. 39. Anconal aspect of the left carpo-metacarpus, *P. sharpei*.

Fig. 40. Superior view of the skull of *P. fuscus*; mandible removed; same specimen as Fig. 35, and the mandible shown in Fig. 41.

Fig. 41. Superior view of the mandible of *P. fuscus*. (See Fig. 40.) The three bits of wax supporting this bone show beneath the articular cups and the symphysis.

PLATE XXVIII. Fig. 42. Dorsal aspect of the sternum and the coössified os furcula of *Pelecanus sharpei;* reduced about one fifth. No. 18,736, Collection in the U. S. Nat. Museum. See Figs. 31, 32 and others of Plate VI. Same skeleton.

Fig. 43. Palmar aspect left pectoral limb of *Phalacrocorax urile.* Reduced about one fourth. From the same skeleton that furnished the skull shown in Fig. 15, Plate IV., and the trunk skeleton shown in Figs. 22 and 23, Pl. V.

Fig. 44. Inner aspect of the right pelvic limb of *Phalacrocorax urile.* Reduced about one fourth from the same skeleton that furnished the pectoral limb shown in Fig. 43.

PLATE XXIX. (Skull, including mandible of *Fregata aquila.* No. 18,485 of the Coll. U. S. Nat. Museum. Adult. All slightly reduced; Fig. 46 more so than the others.) Total length of skull 17.3 centimeters, and ramus of mandible 16.5 cm.

Fig. 45. Left lateral view of the skull; mandible detached.

Fig. 46 Superior view of the skull; mandible removed.

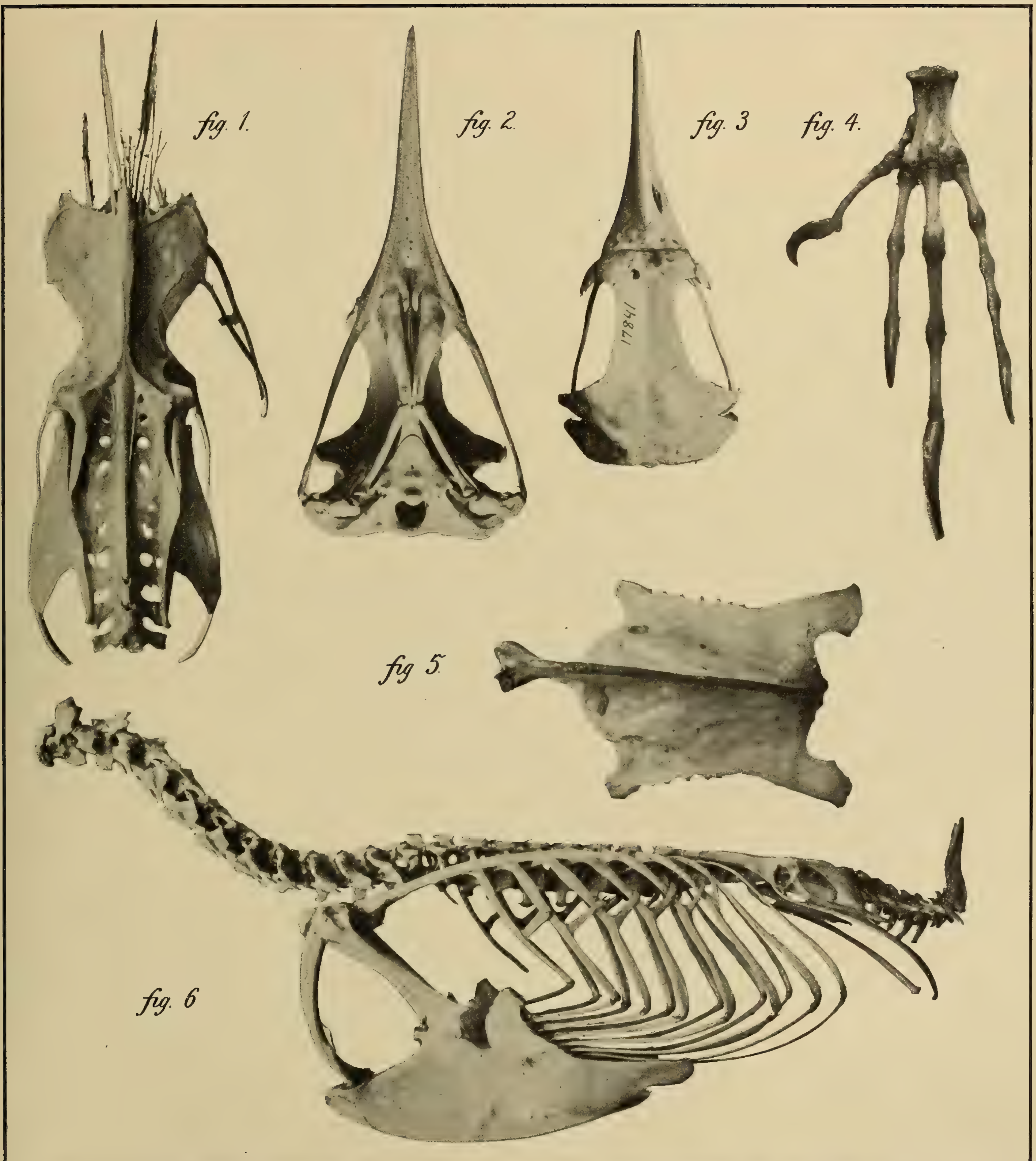
Fig. 47. Superior view of the mandible.

Fig. 48. Basal view of the skull; mandible removed. For other bones of the skeleton of this individual see Plate I., Fig. 4; Plate VI., Figs. 24, 26; Plate X., Figs. 50 and 51. In Fig. 48 the right quadrate bone and the pterygoid of the same side have been removed.

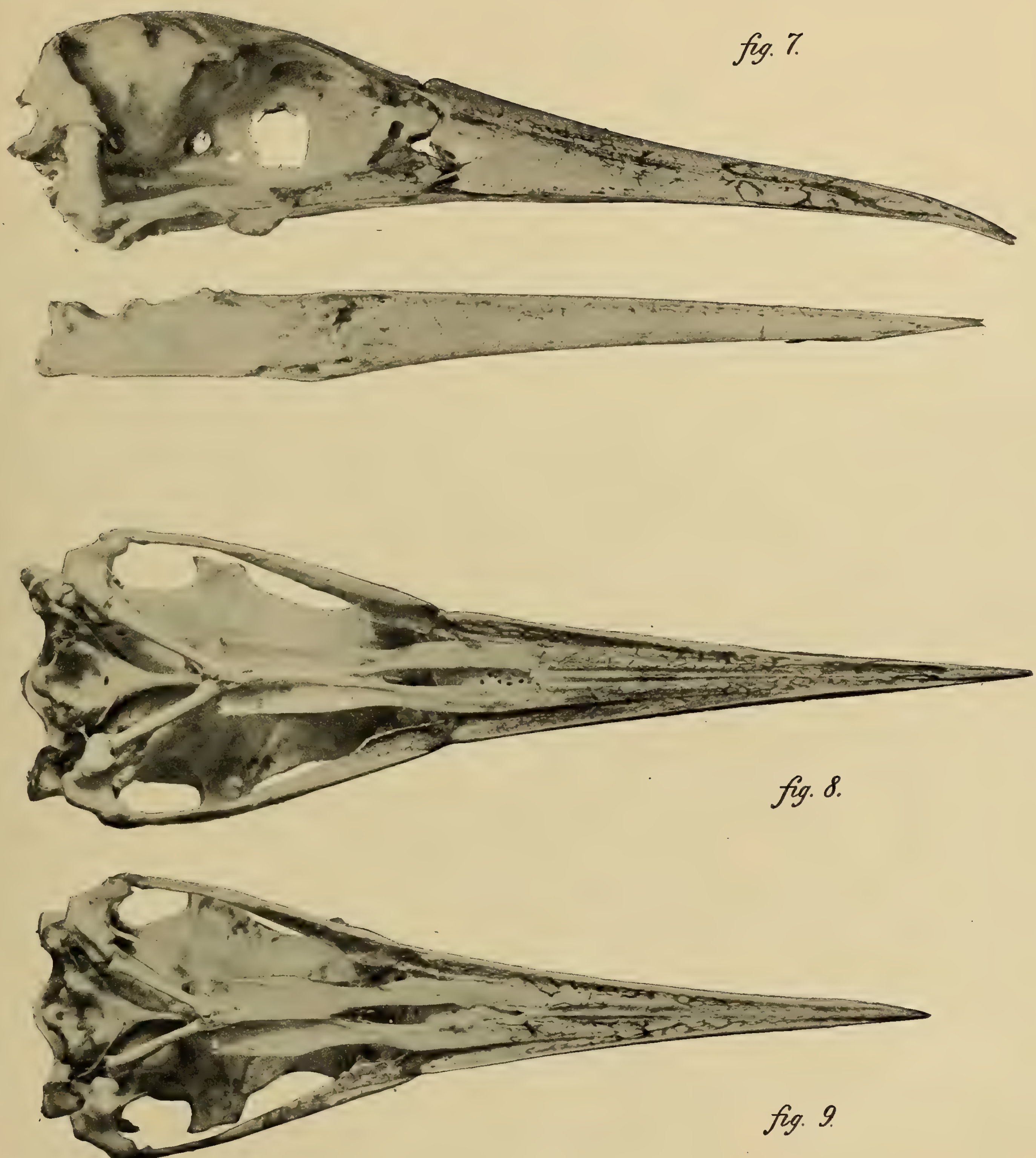
PLATE XXX. Fig. 49. Ventral aspect of the pelvis of *Pelecanus sharpei;* considerably reduced. The longitudinal median line of the vertebral portion of this bone measures about 19.5 cm. It is from the same skeleton that furnished the bones shown in Plate VII.

Fig. 50. Ventral aspect of the sternum and shoulder-girdle of *Fregata aquila;* slightly reduced. See remarks under Fig. 48, Pl. IX.

Fig. 51. Left lateral aspect of the sternum of *Fregata aquila.* Natural size. See remarks under Plate IX. and Fig. 48.



SHUFELDT. OSTEOLOGY OF THE STEGANOPODES. PLATE I.



SHUFELDT. OSTEOLOGY OF THE STEGANOPODES. PLATE II.

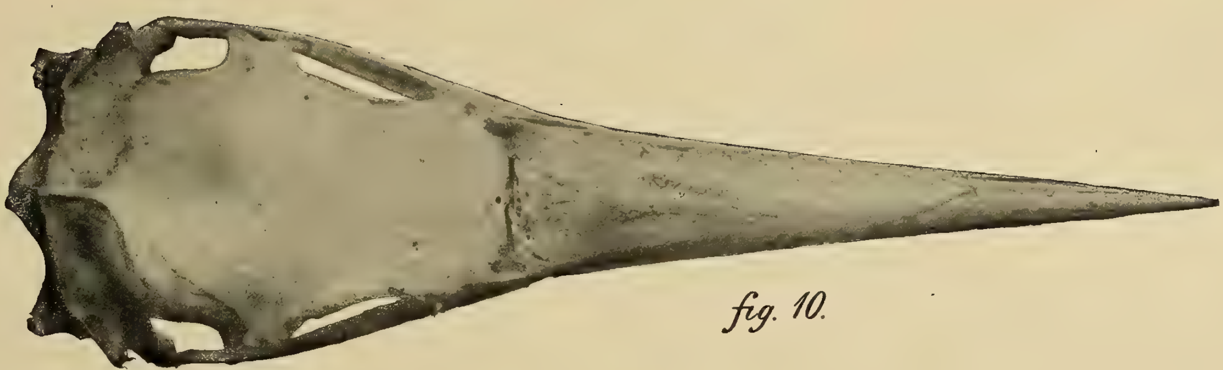


fig. 10.

fig. 11.

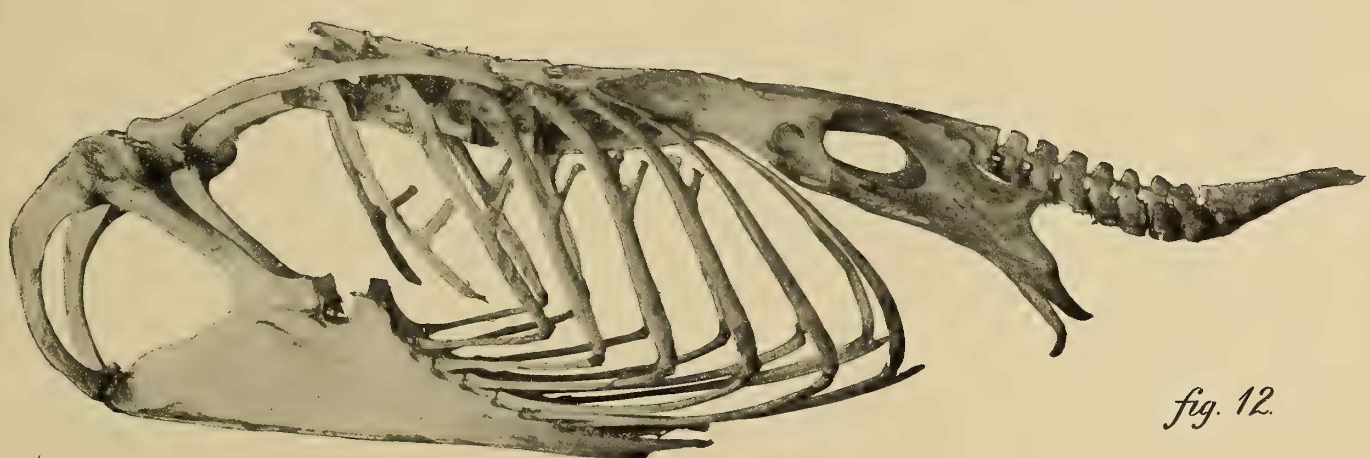
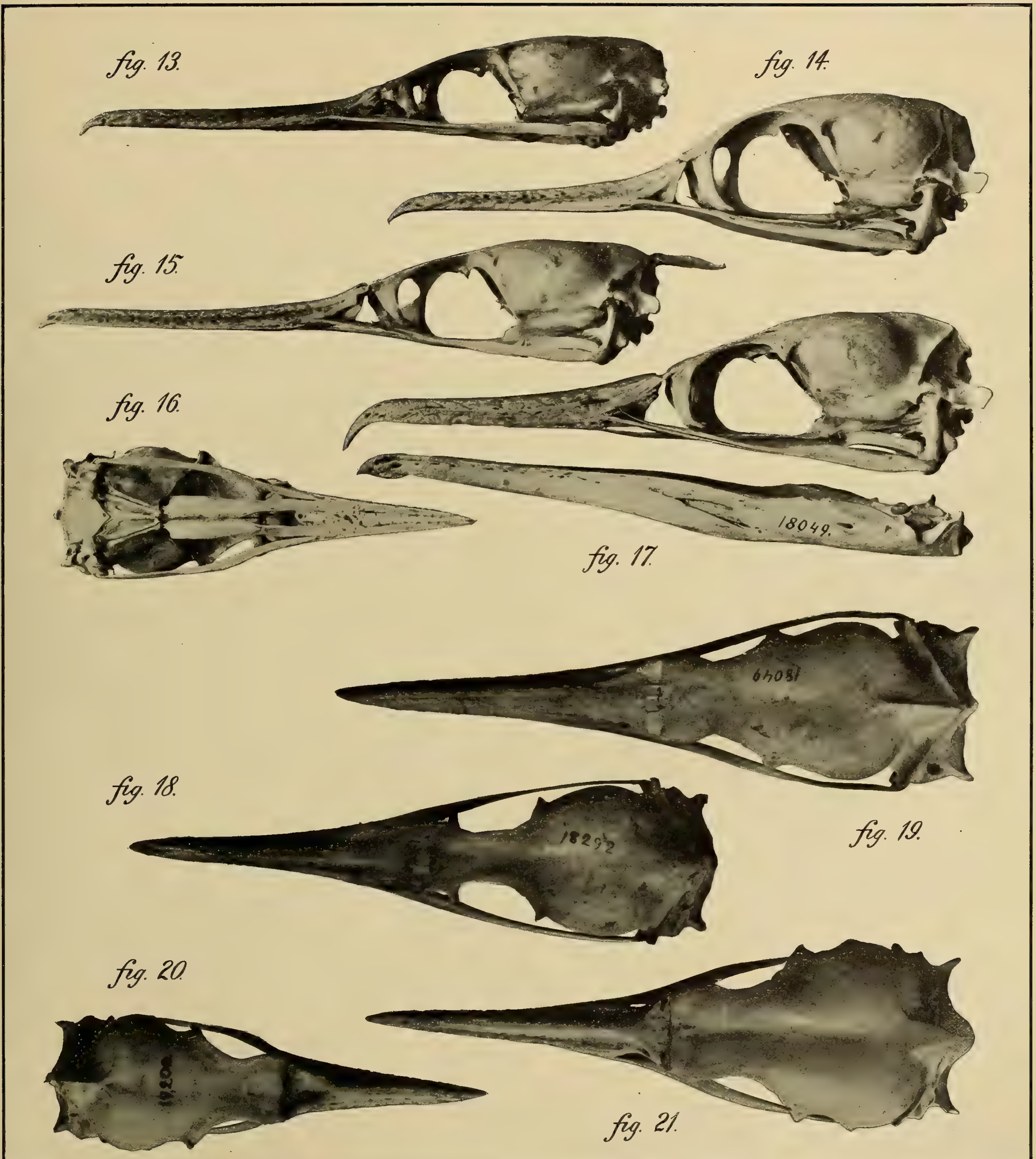


fig. 12.



SHUFELDT. OSTEOLOGY OF THE STEGANOPODES. PLATE IV.

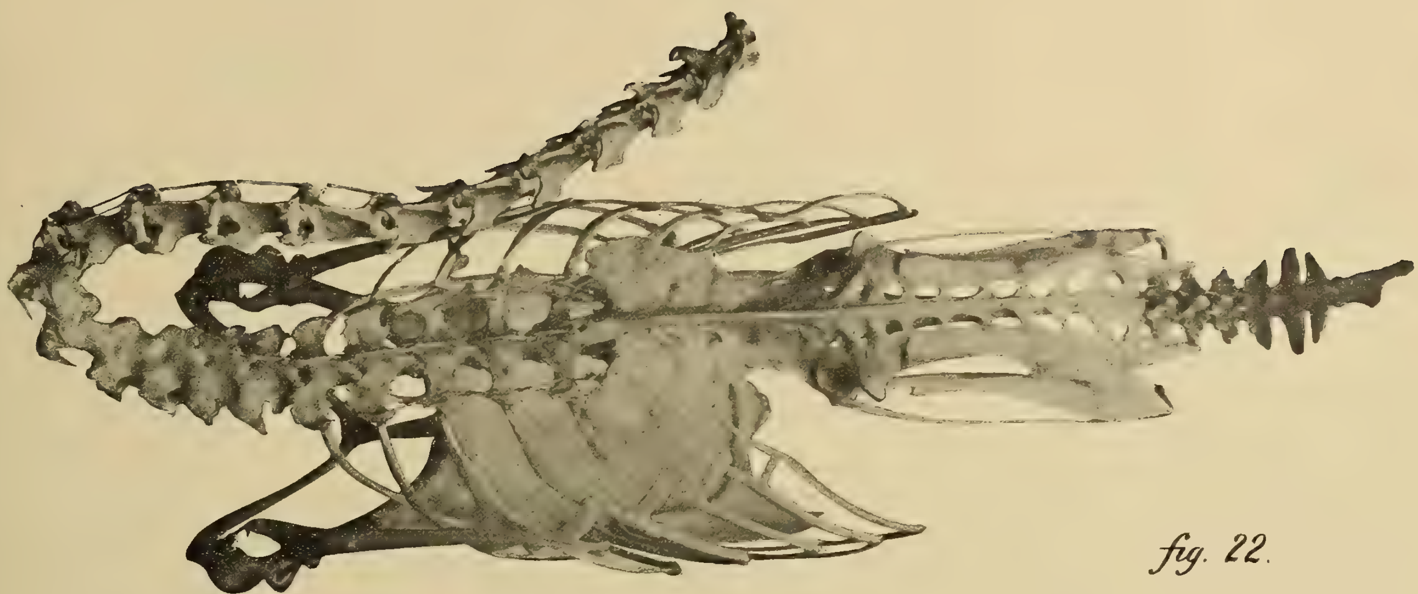


fig. 22.

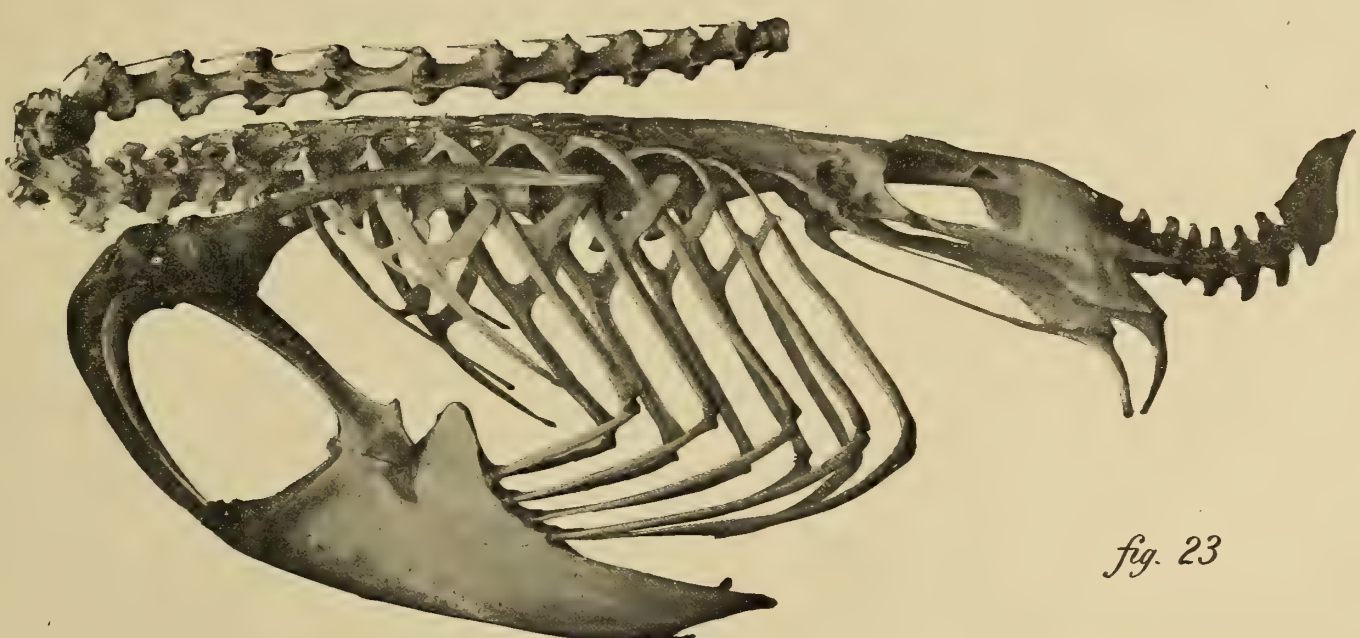
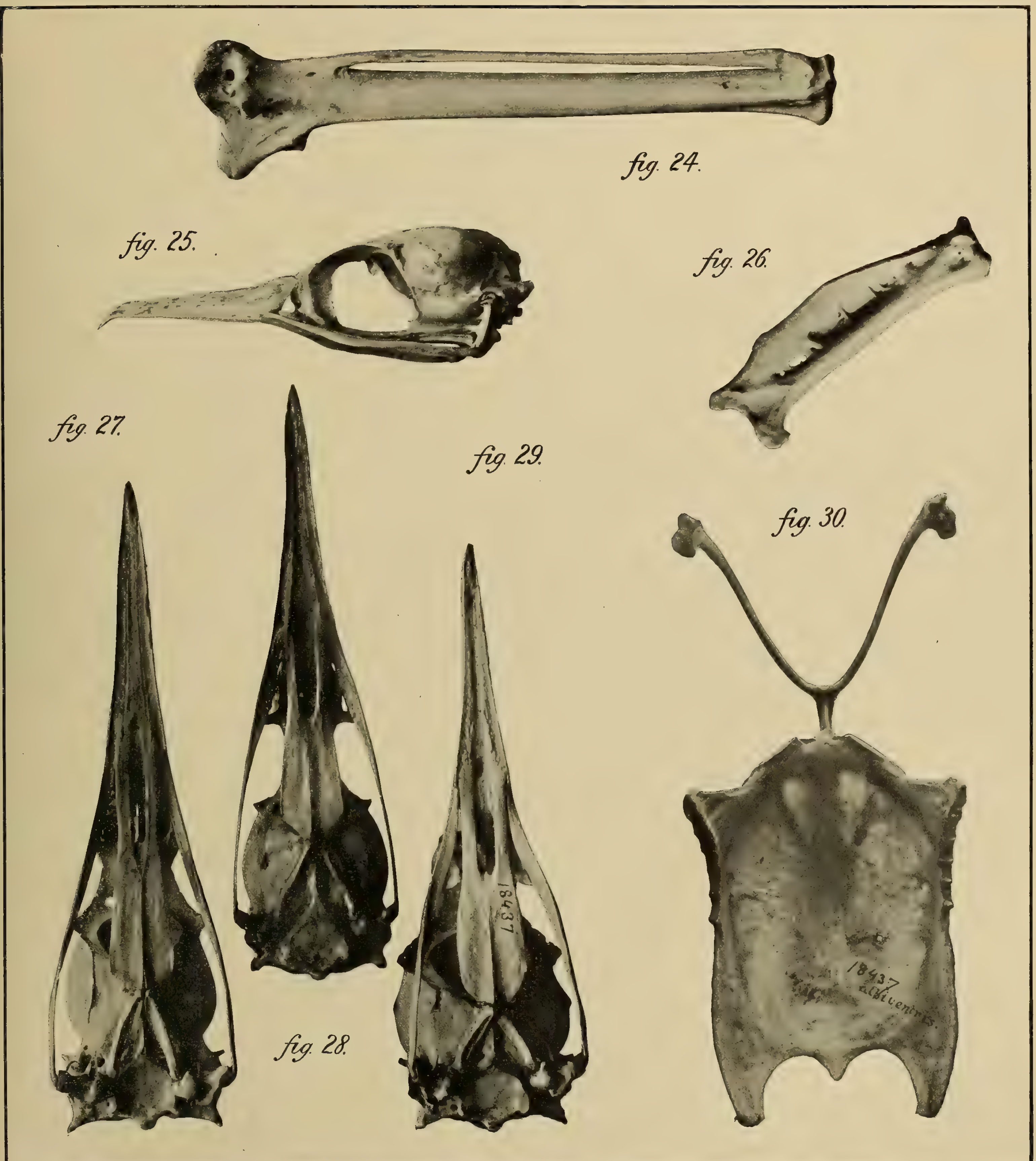
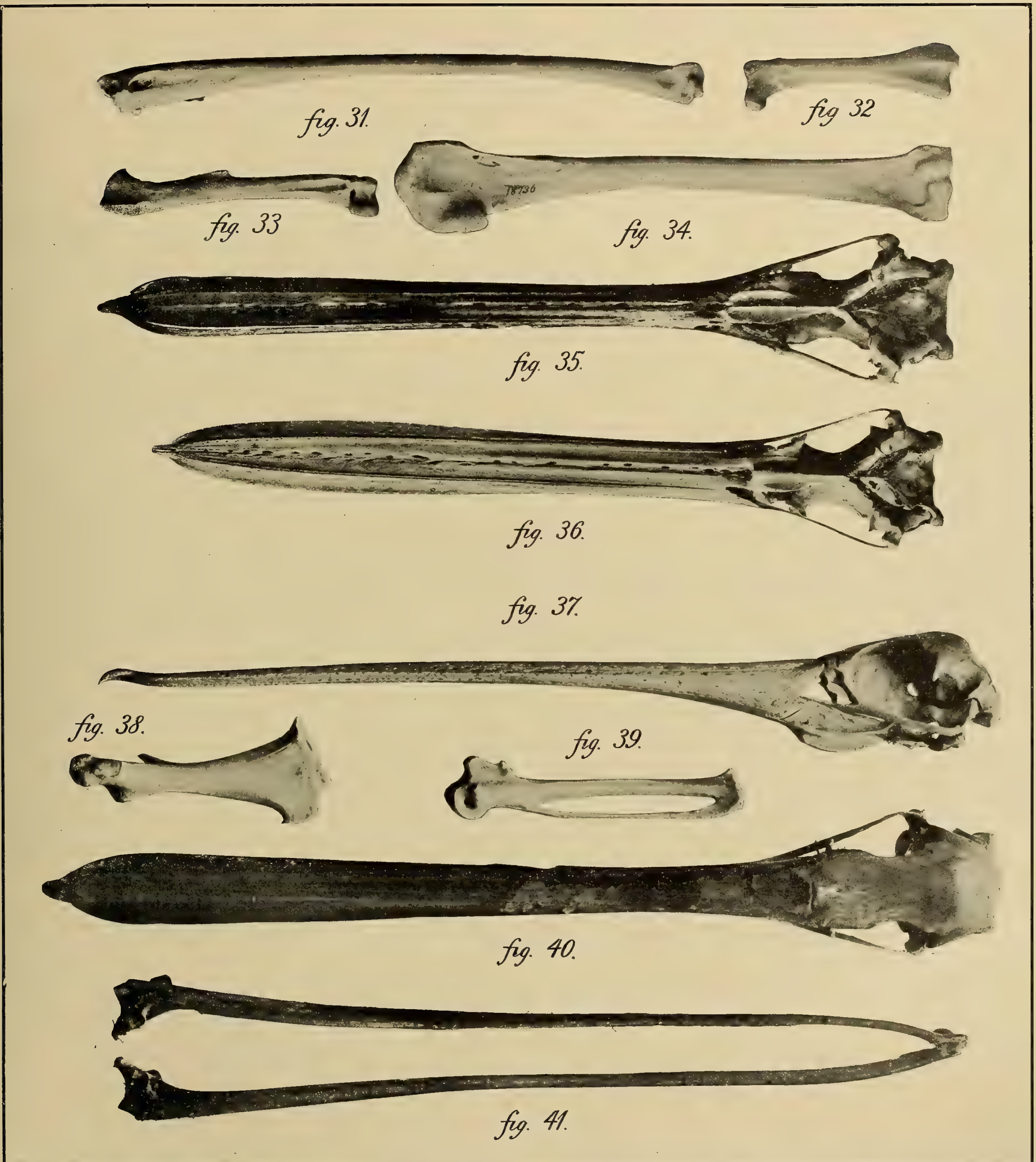


fig. 23

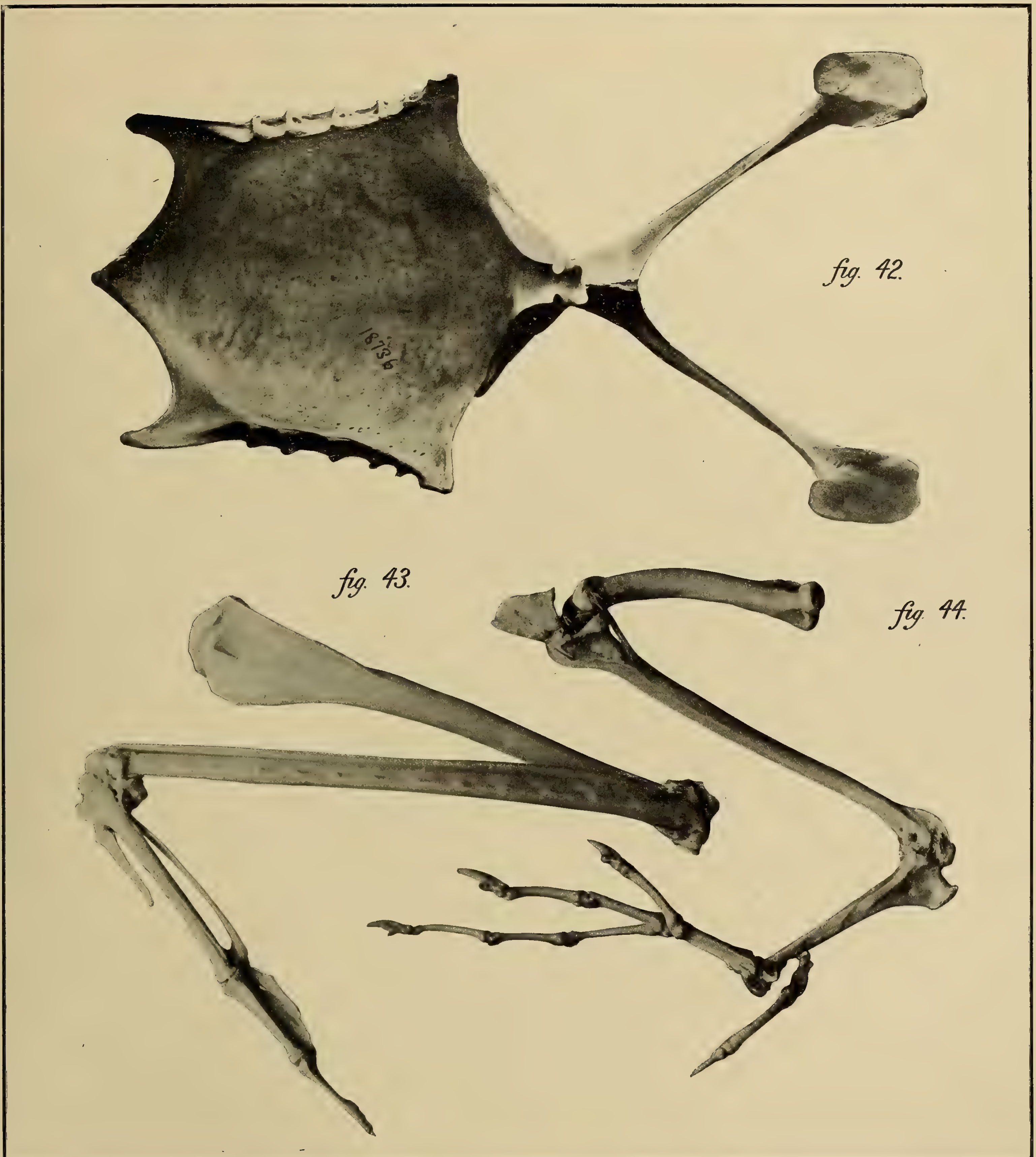
SHUFELDT. OSTEOLOGY OF THE STEGANOPODES. PLATE V.



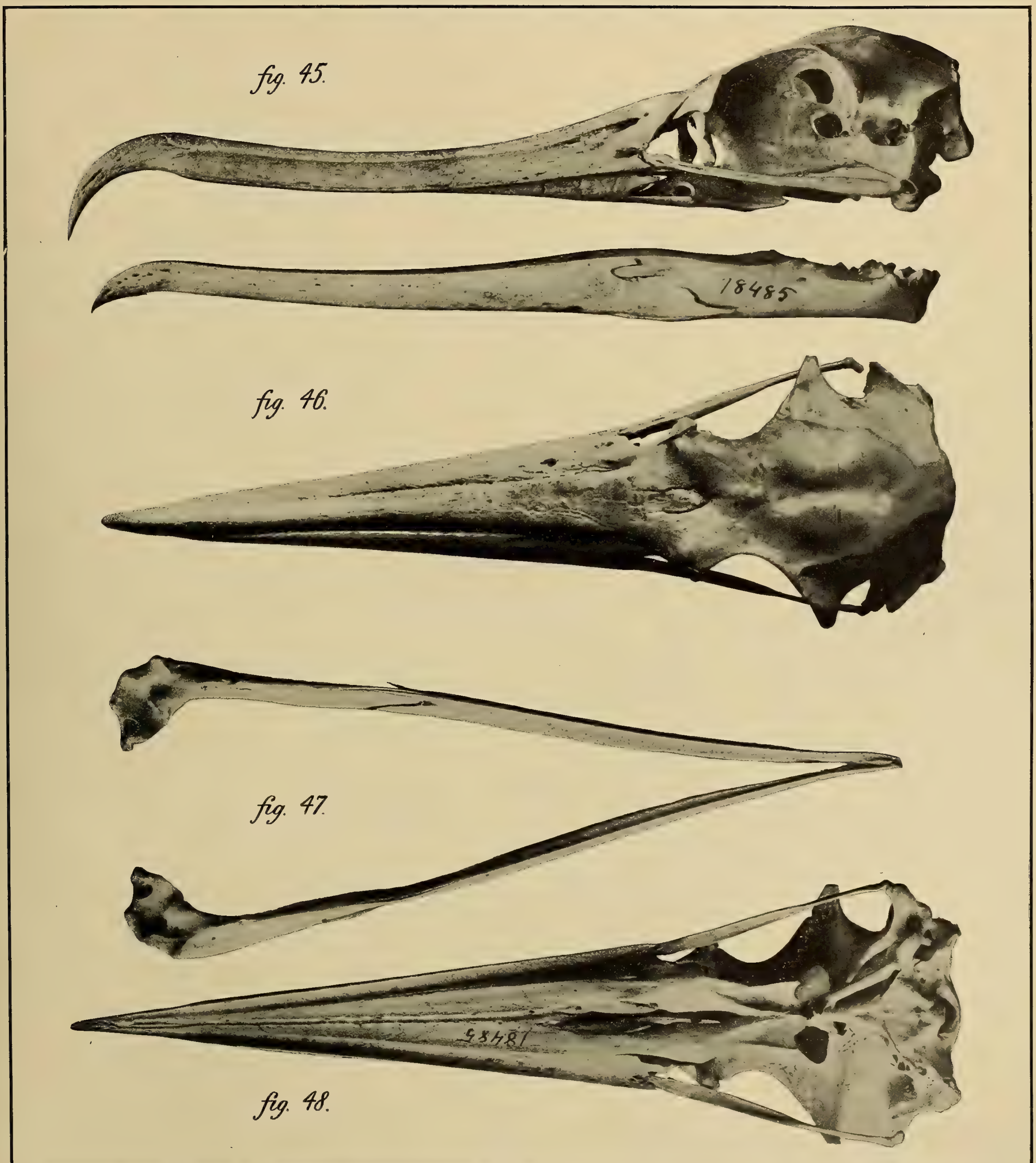
SHUFELDT. OSTEOLOGY OF THE STEGANOPODES. PLATE VI.



SHUFELDT. OSTEOLOGY OF THE STEGANOPODES. PLATE VII.



SHUFELDT. OSTEOLOGY OF THE STEGANOPODES. PLATE VIII.



SHUFELDT. OSTEOLOGY OF THE STEGANOPODES. PLATE IX.

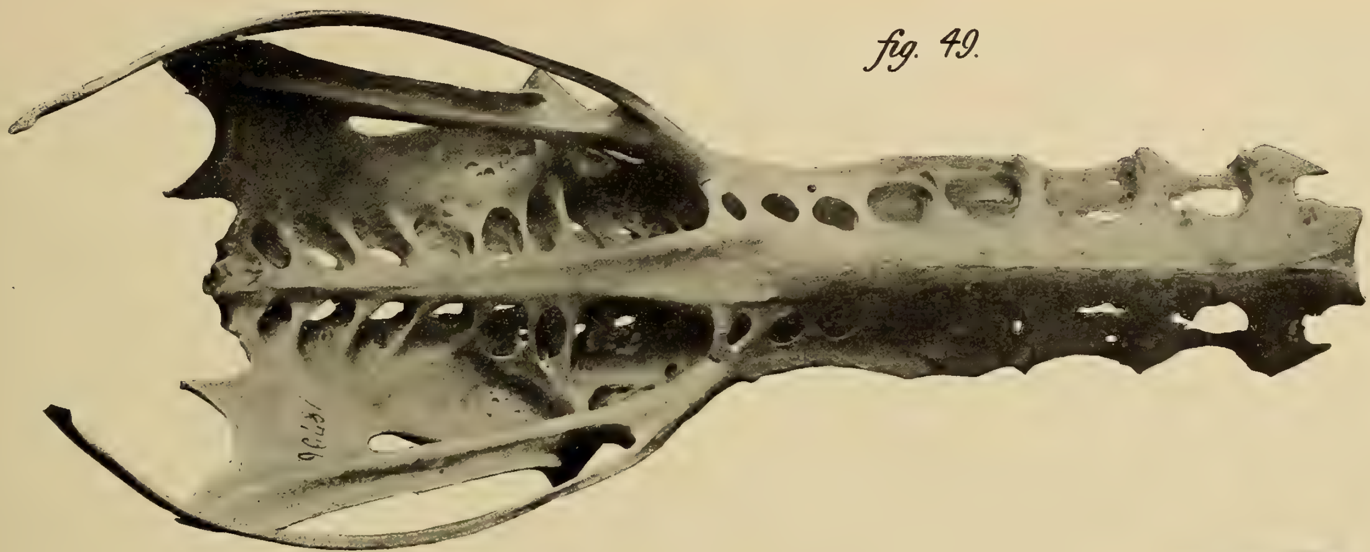


fig. 49.

fig. 50.

fig. 51.

SHUFELDT. OSTEOLOGY OF THE STEGANOPODES. PLATE X.

Publications of the Carnegie Museum. Serial No. 21.

MEMOIRS

OF THE

CARNEGIE MUSEUM.

VOL. I. NO. 4.

W. J. HOLLAND, PH.D., SC.D., LL.D., EDITOR.

J. B. HATCHER, PH.B., ASSOCIATE EDITOR.

CLASSIFICATION OF THE CHALCID FLIES

OR THE

SUPERFAMILY CHALCIDOIDEA,

WITH DESCRIPTIONS OF

NEW SPECIES IN THE CARNEGIE MUSEUM,

COLLECTED IN SOUTH AMERICA BY

HERBERT H. SMITH.

BY WILLIAM HARRIS ASHMEAD, A.M., SC.D.,

ASSISTANT CURATOR, U. S. NATIONAL MUSEUM.

PITTSBURGH.

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THIS VOLUME

IS RESPECTFULLY DEDICATED TO

DR. CARL W. VON DALLA TORRE

THE EMINENT BOTANIST AND HYMENOPTERIST, PROFESSOR IN THE UNIVERSITY OF INNSBRUCK, WHO, IN THE COMPILATION OF "CATALOGUS HYMENOPTERORUM," HAS DONE SO MUCH FOR WORKING HYMENOPTERISTS

THE AUTHOR

WASHINGTON, D. C., January, 1904

TABLE OF CONTENTS.

ERRATA ET CORRIGENDA.

Page 240, line 27, *Otetesella* should read *Otitesella.*
Page 254, line 30, *Anacryptua* should read *Anacryptus.*
Page 261, line 43, *Prodecotoma* should read *Prodecatoma.*
Page 293, line 40, (type *Phœnodescus*) should read *Phœnodiscus.*
Page 297, line 7, *Tetracnemoidea Ashmead* should read *Tetracnemoidea Howard.*
Page 318, line 7, *Nasonia* Ashwood should read *Nasonia* Ashmead.
Page 335, line 33, Australia should read Australian.
Page 339, line 20, Roudani should read Rondani.
Page 342, line 2, *Asecodas* should read *Asecodes.*
Page 347, line 3, Tetrastechinæ should read Tetrastichinæ.
Page 355, line 7, *Stenomesioidea* should read *Stenomesioideus.*
Page 362, line 9, Abdomen petiolate should read abdomen sessile or subsessile.
Page 364, line 38, *Diplalepis* should read *Diplolepis.*
Page 365, line 1, (= *Megastigmus* Dalman) should read (= *Megaspilus* Westwood).
Page 371, line 13, (= *Kriechbaumenella* Dalla Torre) should read (= *Kriechbaumerella*).
Page 373, line 31, *Enargopelte* should read *Euargopelte.*
Page 377, line 32, (type *H. dichrous* Thomson) should read (type *H. niger* Ashmead).
Page 380, line 5, *Lymnœnon* should read *Lymnœon.*
Page 389, line 15, (type *Malea* Ashm.) should read *mellea.*
Page 400, line 19, *Plesiostigmodus* should read *Plesiostigmodes.*
Page 496, line 7, *Parencyrtus brasiliensis* sp. nov. should read *Parencyrtus brasiliensis* Ashmead.
Page 502, line 14, Subfamily V. should read Subfamily IV.
Page 505, line 6, *verticellatus* should read *verticillatus.*
Page 537, line 14, *Dimmoctia* should read *Dimmockia.*

NOTE BY THE AUTHOR.

Some pages of my MS. were lost, either in transmitting or in the printing office, and some species in the Index do not appear in the body of this work. These are:

Decatoma œquiramulis Mayr, *D. breviramulis* Mayr, *D. longiramulis* Mayr, *Spilochalcis mesomela* Walk., *Ceratosmicra flava* Ashmead, and *C. Koeblei* Ashm.

To the Bibliography of the Genera should be added:

Apterolelaps Ashmead, Fauna Hawaiiensis, I., 1901, p. 312 (type *A. nigriceps* Ashm.).
Aseiba Cameron (= Cerchysius Westw. *teste* Howard), Biol. Centr.-Amer. Hym., I., 1889, p. 127.
Bruchobius Ashmead, gen. nov., ante, p. 314 (type B. laticeps Ashm.).
Neocatolaccus Ashmead, gen. nov., ante, p. 320 (type Catolaccus tylodermæ Ashm.).
Neolelaps Ashmead, Fauna Hawaiiensis, I., 1901, p. 312 (type N. hawaiiensis Ashm.).
Packardiella Ashmead, n. n. for Pteratomus Packard, ante, p. 364 (type Pteratomus putnamii Pack.).
Tetracnemoidea Howard, Proc. U. S. Natl. Mus., XXI., 1898, p. 233 (type T. australiensis Howard).
Westwoodella Ashmead, gen. nov., ante, p. 359 (type *Oligosita subfasciata* Westw.).
Xanthoatomus Ashmead, gen. nov., ante p. 360 (type *X. albipes* Ashm.).

MEMOIRS

OF THE

CARNEGIE MUSEUM.

VOL. I. NO. 4.

CLASSIFICATION OF THE SUPERFAMILY CHALCIDOIDEA.

By Wm. Harris Ashmead, A. M.

INTRODUCTION.

About fourteen years ago Mr. Herbert H. Smith placed in my hands for study part of his extensive collection of South American parasitic Hymenoptera, representing the old families *Proctotrypidæ, Cynipidæ* and *Chalcididæ.* The collection was a valuable one and when I took it I confidently expected to find time to finish with it within two or three years; but so much other material was thrust upon me for study that I found it a physical impossibility to do it justice in that length of time; only a few short papers on it have been published. The work accomplished during these past fourteeen years has I think fully demonstrated that I have not been idle, my knowledge of the groups, genera, and species of the Hymenoptera has greatly increased and broadened, and I now feel better able to do justice to the splendid collection received so many years ago.

The Herbert H. Smith collection of insects, made in South America, representing nearly all orders, has been acquired by the Carnegie Museum, Pittsburgh, Pa., and much to my regret, the many fine species, except a set of duplicates in my hands, and which I had always hoped might be secured by the National Museum, must go to that Museum. Dr. W. J. Holland, the Director of the Carnegie Museum, desires now that I complete my work as soon as possible and return the material in my possession. In acceding to this request I have stipulated that he publish my classification of the chalcid-flies, or the Superfamily Chalcidoidea, as a part of this work, and it is through his liberality that I am able to give so many fine illustrations and present in a more attractive form my ideas on the classification of another great complex in the Order Hymenoptera.

The *Proctotrypoidea* and *Cynipoidea* in the collection will be described in another paper.

In this contribution I have restricted myself to elucidating the chalcid-flies and have divided it into two parts. The first part is devoted to a classification of the superfamily Chalcidoidea; the second part deals with the South American Chalcidoidea. In this latter part, besides my report upon the Herbert H. Smith collection, the descriptions of the new genera and species, is given a complete bibliographical catalogue of all the known South American species.

PART I. CLASSIFICATION OF THE CHALCID-FLIES, OR THE SUPERFAMILY CHALCIDOIDEA.

Among the ten great groups or superfamilies of the Hymenoptera, recognized by the author, there is none so large numerically, more important economically, or so difficult to study and classify as the superfamily Chalcidoidea or the Chalcid-flies. The species exist everywhere not by hundreds, but by thousands and millions, and they are probably of far greater importance, from an economic standpoint, than are the Ichneumonoidea or ichneumon-flies.

Only a few of them, comparatively speaking, are in any sense injurious, a single minor group, the tribe *Isosomini*, in the family Eurytomidæ, alone being injurious to vegetation. All the others, except the fig-insects forming the family *Agaonidæ*, the *Megastigminæ*, a subfamily in the Torymidæ, and some few hyperparasitic genera in different families, being genuine parasites and beneficial to man. It is true, however, that some of the chalcid-flies destroy a few beneficial insects, but the vast majority of the known species destroy mostly the injurious species in the other orders, *i. e.*, the Coleoptera, the Lepidoptera, the Diptera, the Rhynchota, etc.; they attack the eggs, the larvæ, and the pupæ, and in some cases even the imagoes of their hosts, and their value to many great industries of the world cannot easily be estimated. Who, for example, can estimate the value of the fig-insects to the fig industry of the United States? Through the efforts of Dr. L. O. Howard and Mr. W. T. Swingle, of the U. S. Department of Agriculture, the caprifier of the Smyrna fig, *Blastophaga psenes* Linné (*grossorum* Gravenhorst), has been successfully introduced into the fig-orchards of California, and the experiments already made fully demonstrate the great value this little chalcid-fly has to the fig industry. It is evidently destined to revolutionize fig-growing in the United States, making it exceedingly profitable, and, on account of the superiority of the American-grown

Smyrna fig pollenized by these Chalcid-flies, will in time diminish the importation of the Smyrna fig. The *Megastigminæ* too, I suspect, are like the fig-insects, and will be found to be of great importance as pollenizers of various plants and trees.

At present the known genera and species of the Chalcidoidea are considerably less in number than are the Ichneumonoidea recently classified by the writer; but this is due simply to the fact that the literature on the subject, in various languages, is widely scattered, in many foreign journals, magazines, proceedings of learned societies, etc., and the minute size of most of the species and the difficulty of their study, have deterred entomologists from giving them any attention. Only a little over 5,000 species have been described.

If we look back for a century and a half we find comparatively few who have given much attention to these "atoms of creation," and of these a few names only stand out conspicuously as students of this great complex. The study of the group began about one hundred and fifty years ago with Linnæus in Sweden and with Geoffroy in France. Linné, or Linnæus, in his Systema Natura, tenth edition, published in 1758, described several species under his genera *Ichneumon, Cynips, Sphex,* etc. Others took up their study, and an interest in them was aroused in Sweden, Austria, Germany, France, Italy, and England. In Sweden, besides Linné, Swederus, Fabricius, Zetterstedt, Dalman, Boheman, Dahlbom and Thomson did much valuable work in the group; in Germany, Klug, Nees von Esenbeck, Bouché, Ratzeburg, and Förster—the last mentioned, the greatest systematic worker in the group; in Austria, Reinhard and Mayr; in Russia, Motschulsky; in France, Geoffroy, Latreille, Fonscolombe, Perty, Guérin, Giraud, Sichel, and André; in Italy, Spinola and Rondani; in England, Curtis, Haliday, Westwood, Walker, Saunders, Kirby, and Cameron; and in America, Say, Fitch, Cresson, Walsh, Riley, Provancher, Howard, and Ashmead. A few others might be mentioned, but those specified are the ones whose names stand out prominently as adding materially to our knowledge of the group during the eighteenth and nineteenth centuries.

For years I have been studying this great complex and in the following pages have attempted to define the families, subfamilies, tribes, and genera of the world. The work has been a gigantic and most laborious one, necessitating the microscopic examination of many thousands of these minute creatures; but if it shall be found that I have brought some order into their classification, that I shall excite an interest in the collecting of the many thousands still unknown, and that I shall stimulate others to study them, my time has not been wasted and I shall be amply repaid.

Superfamily VII. *CHALCIDOIDEA.*

1758. Cynips, Linné (partim), Syst. nat., Ed. 10^a, I., p. 343.
1802–05. Diplolepaires, Familie soixante deuxième (partim) Latreille, Hist. Nat. Crust. et Ins., XIII., p. 198.
1802–05. Cynipseres, Familie soixante-troisième (partim), opus. cit., p. 211.
1809. Diploleparieæ, Familia quinta (partim) Latreille, Gen. Crust. et Ins., III., p. 15.
1809. Cynipsera, Familia sexta (partim) Latreille, opus. cit., supra, p. 21.
1811. Diploleparia, Familia (partim) Spinola, Ann. du Mus. Natur., XVII., p. 138.
1820. Pteromalini, Familia (partim) Dalman, Kongl. Svensk. Vet.-Akad. Handl., p. 132.
1825. Chalcidites, Quatrième Tribu (partim) Latreille, Fam. Natur. d. Règne anim., p. 446.
1830. Chalcida, Family, Leach, Edinb. Encycl., IX., p. 144.
1840. Chalcididæ, Family, Westwood, Intro. Mod. Class. Ins., II., p. 154.
1846. Chalcidites, Order, Walker, List Chalc. Brit. Museum, I., p. 1.
1856. Chalcidiæ, Förster, Hym. Stud., II., pp. 1–90.
1875. Pteromalidæ, Familia, Thomson, Hym. Skand., IV., p. 3.
1877. Chalcidita, Tribe 4, Förster, Ueber den Syst. Werth d. Flügelg. bei d. Hym., p. 19.
1886. Chalcididæ, Family, Howard, Ent. Amer., I., p. 197.
1897. Chalcidoidea, Superfamily VII., Ashmead, Proc. Ent. Soc. Washington, IV., p. 243.

TABLE OF FAMILIES.

1. Hind wings exceedingly narrow, linear, pedunculate at base; ovipositor issuing from beneath just anterior to tip of abdomen; antennæ without a ring-joint, the scape rather small, short, compressed...... 12
   Hind wings never very narrow, nor linear, not pedunculate at base; ovipositor issuing far anterior to the tip of abdomen; antennæ elbowed, with 1, 2, or 3 ring-joints, very rarely without, the scape large and rather long. 2
2. Axillæ triangularly produced or advanced forward into the basal region of the scapulæ, their base or anterior margin *on* or *in advance* of an imaginary line drawn from tegula to tegula; anterior tibial spur most frequently small or weak; tarsi 3–4-jointed, rarely 5-jointed or heteromerous........... 10
   Axillæ normal, or at least never produced forward into the basal region of the scapulæ, their base or anterior margin straight and always back of an imaginary line drawn from tegula to tegula; anterior tibial spur large and strong; tarsi 5-jointed (rarely 4-jointed, or 3- or 4-jointed in some wingless males) 3
3. Head in ♀ oblong, with a deep, broad longitudinal furrow above, the occipital margin superiorly, usually with a small recurved tubercle or spine at its middle; mandibles or palpi most frequently furnished with saw-like appendages; anterior and posterior legs very stout, their tibiæ very much shorter than their femora, the middle legs very slender, sometimes aborted; hypopygium very

prominent, acute, cultriform or lanceolate; ovipositor long, prominently exserted; ♂ always apterous, the head anteriorly with a deep triangular fovea, in which are placed the short 3–9-jointed antennæ; the abdomen in the ♂ is broadly sessile, long and tubular, thickened at base, or broadened apically with a tubercle or filament at each apical angle.......Family LX. AGAONIDÆ.

Head rarely oblong and quite differently formed, never with a deep broad longitudinal furrow above, most frequently transverse, or subquadrate, the occipital margin never with a small recurved spine; mandibles and palpi without saw-like appendages; middle legs not especially slender, the anterior and posterior legs are often stout, but their tibiæ are always longer, at least never shorter than their femora; hypopygium rarely very prominent; ♂ most frequently winged, rarely apterous; in the latter case the abdomen is normal, not long and tubular.

Mesopleura large, entire, without a femoral furrow, except occasionally in some males, the mesepisternum large, triangular, not extending to base of front coxæ; middle tibial spur saltatorial, most frequently long and stout, or dilated at base.......................... 8

Mesopleura always with a femoral furrow or impression, the mesepisternum variable, rarely large, except in the *Cleonymidæ*, most frequently small, wedge-shaped, or linear and extending to base of front coxæ; if large and triangular, either the anterior or the posterior femora are much swollen; middle tibial spur not saltatorial, usually short or weak, never very stout.

Hind tibiæ with 2 apical spurs, rarely with 1 only; in the latter case the radius terminates in a large, rounded stigma, the ovipositor very long........................ 4

Hind tibiæ with 1 apical spur; ovipositor rarely long; if long the stigma is small..... 9

4. Mandibles falcate, usually with 1 or 2 teeth within; thorax most frequently very gibbous, the scutellum usually very large, often abnormally developed, elevated and produced posteriorly, the axillæ connate, not distinctly separated from the surrounding surface and broadly united along their inner margins.. 6

Mandibles usually 3–4-dentate at apex, rarely falcate, with 1 or 2 teeth within; thorax not, or very slightly, gibbous, the axillæ distinctly separate, their inner margins most frequently widely separated, very rarely touching.

Hind coxæ rarely much larger than the anterior coxæ, most frequently smaller or equal; if much larger, the pronotum is elongate, mesepisternum large, the hind legs very long, the postmarginal vein very long; ovipositor very rarely prominent.......................... 5

Hind coxæ very large and long, usually five or six times larger than the anterior coxæ.

Hind coxæ subtriquetrous, or at least compressed into a sharp ridge above; hind femora rarely very much swollen, and most frequently simple, rarely with one large tooth or denticulate beneath; hind tibia usually straight; abdomen most frequently subcompressed (more rarely depressed), with a long ovipositor; if without an exserted ovipositor, the abdomen is conical or conic-ovate with a peculiar sculpture, the radius (stigmal vein) usually very short, the hind tibiæ at apex normal......... Family LXI. TORYMIDÆ.

Hind coxæ usually very long and subcylindrical; hind femora always much swollen and most frequently armed with teeth beneath or finely serrated, rarely without teeth; hind tibiæ strongly curved and obliquely truncately produced at apex, so that the tarsi seem to be attached a little before tips; abdomen of various shapes, most frequently conical or conic-ovate, more rarely globose, or oblong-oval, the ovipositor very rarely prominent; radius variable, rarely very short.......... Family LXII. CHALCIDIDÆ.

5. Pronotum rarely transverse quadrate, conical or conically produced anteriorly, or very short, transverse linear, and very much narrowed medially, rarely as wide as the mesonotum.............. 7

Pronotum large, quadrate or transverse quadrate, never very short, if somewhat shortened always as wide as the mesonotum.

Pronotum quadrate or subquadrate; abdomen in ♀ not triangulated, either globose, ovate, conic-ovate or lanceolate and compressed or subcompressed, the hypopygium most frequently prominent plowshare-shaped; second dorsal segment never very large; mandibles not strong, most frequently 4-dentate . . . . Family LXIII. EURYTOMIDÆ.

Pronotum shorter, more transverse and as wide as the mesonotum; abdomen in ♀ most frequently triangulated, or globose, the second and third segments occupying most of the dorsal surface, the following very short and more or less retracted within the third; hypopygium not prominent; mandibles 2- or 3-dentate at apex . . . . Family LXIV. PERILAMPIDÆ.

6. Second abdominal segment very large and most frequently enclosing the following; coxæ not large, subglobose, nearly equal; all legs very slender; radius scarcely developed, its stigma sessile or subsessile . . . . Family LXV. EUCHARIDÆ.

7. Mesepisternum not large, triangular; anterior femora never much swollen, the posterior femora also normal or only slightly swollen; marginal vein in hind wings usually long, the costal cell not reaching to the hooklets or spinulæ and most frequently very narrow; radius well developed.
Family LXVI. MISCOGASTERIDÆ.

Mesepisternum large, triangular; either the anterior or the posterior femora are much swollen and sometimes toothed, or both are swollen with the hind femora toothed; if with slender legs, the hind legs are very long, their coxæ long, cylindrical, while the radius (stigmal vein) in front wings is very short, with the postmarginal vein very long extending to the apex of the wing (*Pelecinella*).
Family LXVII. CLEONYMIDÆ.

8. Mesonotum either depressed, with more or less distinct parapsidal furrows, the scapulæ longitudinally ridged, or convex or subconvex, entirely without furrows, rarely convex with distinct furrows; axillæ most frequently meeting at inner basal angles, rarely very widely separated.
Family LXVIII. ENCYRTIDÆ.

9. Mesonotum subconvex with incomplete or complete parapsidal furrows; hind coxæ rarely much larger than the front coxæ; axillæ separated, not meeting at inner basal angles; mesepisternum usually small, wedge-shaped or triangular; hind wings with a long marginal vein; mandibles usually stout, 3- or 4-dentate at apex . . . . Family LXIX. PTEROMALIDÆ.

10. Hind coxæ normal; mesopleura impressed 11

Hind coxæ abnormally large and dilated, their femora flat or compressed; tarsi very long; mesopleura entire, not impressed; marginal vein in front wings most frequently extraordinarily lengthened, the radius very short, scarcely dilated; mesonotum without furrows . . . . . . Family LXX. ELASMIDÆ.

11. Tarsi 4–5-jointed, rarely heteromerous; anterior wings not short and broad, with the pubescence normal, marginal and radial veins normal; postmarginal vein often wanting; mesonotum with complete or incomplete furrows . . . . Family LXXI. EULOPHIDÆ.

Tarsi 3-jointed; anterior wings short and broad, broadly rounded at apex with the pubescences most frequently arranged in rows, more rarely normally pubescent; marginal and radial veins united in the form of a strongly curved line ∩ . . . . Family LXXII. TRICHOGRAMMIDÆ.

12. Pronotum usually large, rounded, or conically produced anteriorly; wings always with a long marginal fringe, nearly veinless and always without a radius (stigmal vein), the marginal vein most frequently reduced to a mere dot; antennæ in ♀ most frequently terminating in a distinct fusiform or egg-shaped solid club, more rarely with a 2-jointed club; tarsi 4–5-jointed.
Family LXXIII. MYMARIDÆ.

Family LX. AGAONIDÆ.

1846. Agaonidæ, Family 6 (partim) Walker, List Chalc. Brit. Museum, I., p. 23.
1856. Agaonoidæ, Familie (S. descrip.) Förster, Hym. Stud., II., p. 29.
1871. Agaonidæ, Family (partim) Walker, Notes on Chalc., Pt. IV., p. 58.
1867. Blastophagidæ, Familia, Kirchner, Cat. Hym. Eur., p. 188.
1882. Cynipidæ, Sycophagides, Division 1, Saunders, Trans. Ent. Soc. London, p. 20.
1897. Agaonidæ, Family LX., Ashmead, Proc. Ent. Soc. Washington, IV., p. 243.

This family is one of the most striking and remarkable of any in the superfamily Chalcidoidea. It is based upon the genus *Agaon* Dalman, established in 1818, from a specimen taken in Sierra Leone, Africa.

The species composing this family, on account of their habits, curious forms, and the diversity of structure in the sexes, were long a puzzle to the ablest and most astute of the European hymenopterologists, but it is now definitely settled that they form a component of this great complex. Sir Sidney Saunders, as late as 1883, placed them as a division with the family *Cynipidæ*. In my opinion, however, they have little in common with the Cynipoidea, and I concur with Walker, Westwood, and Mayr, in believing them a component of this major group.

Mr. Francis Walker, an Englishman, was the first to give the group family rank; but, as is the case with most of his families, he never properly defined or characterized it, and merely lumped together a miscellaneous lot of insects obtained from figs, and called them a family — the Agaonidæ. His ideas of the family were extremely vague and indefinite, and he placed in it many forms with which they had no relationship.

In 1871, Walker, in speaking of them said: "The Agaonidæ appear as yet chiefly in three aspects, and in three different regions. The first region is the Mauritius, where they have been discovered by the researches of Dr. Coquerel. The three species figured are said to be 'condemned to eternal darkness' in the central regions of figs. These figs are the fruit of *Ficus terragena* and are unfit for human food. Dr. Coquerel found the three species (*Apocrypta paradoxa, A. perplexa* and *Sycocrypta caeca*) in abundance in the interior of these figs, together with great numbers of a fourth species, which he named *Chalcis? explorator* and which he believed to be parasitic on the other three species. Dr. Coquerel thought he saw an affinity between them and certain Bethylids, *Scleroderma contractor*, etc."

Walker thought they had more connection with certain South American and Australian *Thynnidæ*. He says: "*Scleroderma* seems to have more affinity with *Typhlopone*, the worker of *Labidus*, and with *Dichthadia glaberrima*, the supposed female of *Dorylus;* and thereby the multitudinous tribe of ants whose economy is

so remarkable, emerges from blind and radical *Apocryptæ* and *Sycocryptæ*, the perpetual dwellers in the interior of figs." "But the affinity of these two genera to the *Chalcidiæ* is more evident and appears by several connecting links in the *Agaonidæ;* and thus the near relation to the general ancestors of the thousands and perhaps tens of thousands of the Chalcidiæ species, the tribe being considered in unity, are cradled in figs."

Our knowledge of fig-insects, within the past twenty-five years, has been very greatly augmented by the studies of Prof. John O. Westwood and Sir Sidney Saunders, of England, Dr. Gustav Mayr, of Vienna, Austria, Dr. Paul Mayer, of the Naples Station, Italy, and my own studies on some Florida, Mexican and West Indies species, so that to-day sufficient forms are known in both sexes to enable me to segregate, define and place in their proper groups, the miscellaneous insects known as fig-insects.

In this work I have restricted the *Agaonidæ* to the caprifiers, or true fig-insects, chalcid-flies that live in and pollenize, or fructify, fig-trees.

The others, heretofore classified with them, belong elsewhere, in three or four different families, and are either inquilinous or genuine parasites. Some, the vast majority, belong to the *Torymidæ*, while others belong to the *Chalcididæ, Miscogasteridæ, Pteromalidæ*, etc.

All fig-trees, in a wild state, are diœcious and wherever fig-trees grow, principally in tropical and semi-tropical countries, there also will be found fig-insects, for these microscopic creatures are essential to their pollenization.

Undoubtedly, judging from the great number of fig-trees known to botanists, many genera and hundreds of species still remain unknown to us.

Among the genuine fig-insects, two well-marked subfamilies may be distinguished, separable by the aid of the following table:

TABLE OF SUBFAMILIES.

Abdomen in ♀ subcompressed, the ovipositor prominent, the mandibles *with* an appendage, usually serrate; males apterous, the abdomen long, narrowed towards apex and curving beneath the thorax. Subfamily I. AGAONINÆ.

Abdomen in ♀ subcompressed, the ovipositor prominent, the mandibles *without* an appendage, the palpi sometimes *with* an appendage; otherwise similar to the Agaoninæ; males apterous, the abdomen broadened towards apex, narrowed towards the base, and with a tubercle or long filament at each apical angle........Subfamily II. SYCOPHAGINÆ.

SUBFAMILY I. AGAONINÆ.

1883. Cynipidæ, Division I., Sycophagides (partim), Saunders, Trans. Ent. Soc. London, 1883, p. 20.

The males in this subfamily are easily distinguished from those in the next by the shape of the abdomen, which is always long and tubular, narrowed toward apex and never broadened at apex as in the *Sycophaginæ*. It is also more flexible and is usually curved or bent forward under the thorax.

The females are more difficult to separate and, although with practice one can detect a difference in cephalic characters, almost impossible to define, the only reliable character to separate them from those in the other subfamily is the mandibular appendage, which is usually finely serrate. In the *Sycophaginæ* the mandibles are always *without* an appendage.

The known genera falling in this group may be easily recognized by the use of the following table:

TABLE OF GENERA.

1. Females, always winged.......... 2
   Males, always apterous.......... 10
2. Antennæ with the third or fourth joint *with* a distinct process.......... 3
   Antennæ *without* a joint with a distinct proces.......... 9
3. Front wings *with* the marginal, stigmal and postmarginal veins fully developed, or at the most with the postmarginal vein absent.......... 4
   Front wings *without* marginal, stigmal and postmarginal veins.
   Head oblong, about 1½ times as long as wide; antennæ 11-jointed, thickened toward apex.
   Eupristina Saunders (type *E. masonii* Saund.).
4 Postmarginal vein present.......... 5
   Postmarginal vein absent.......... 7
5. Antennæ 11 or 12-jointed.......... 6
   Antennæ 10-jointed, the last five joints enlarged.......**Kradibia** Saunders (type *K. cowanii* Saunders).
6. Head not very long, quadrate or nearly so.......... 8
   Head oblong, or very long, from 2½ to 3 times as long as wide, the facial channel narrow; mandibles at apex bidentate; antennæ 11-jointed.........**Pleistodontes** Saunders (type *P. imperialis* Saunders).
7. Head quadrate or nearly, only a little narrower in front than behind; stigmal vein usually a little longer than the marginal..................**Eisenia** Ashmead gen. nov. (type *E. mexicana* Ashm.).
8. Seventh abdominal segment on each side with a small *rounded* or at most oval spiracular fovea.
   Blastophagus Gravenhorst (type *Cynips psenes* Linné).
   Seventh abdominal segment on each side with an *elongate*, disk-shaped, spiracular fovea.
   Ceratosolens Mayr (type *C. appendiculatus* Mayr).
9. Front wings with the marginal, stigmal and postmarginal veins wanting; head trapezoidal, a little longer than wide; antennæ 11-jointed, not thickened towards apex, the joints smooth; middle legs very minute or subobsolete..........................**Tetrapus** Mayr (type *T. americanus* Mayr).
   Front wings with the marginal, stigmal and postmarginal veins present; head oblong, 2½ times as long as wide; antennæ (?) 12-jointed, the scape large, triangularly dilated, the funicle slender, filiform, the club abruptly enlarged, 3-jointed; mandibles 3-dentate; thorax bidentate at each side.
   Agaon Dalman (type *A. paradoxum* Dalm.).
10. Head anteriorly *with* a large, deep, triangular fovea.
    Basal part of antennæ enclosed in a canal.......... 11
    Basal part of antennæ *not* enclosed in a canal.......... 12

11. Front tarsi 2-jointed, the front and hind femora stout and more or less compressed; eyes very small or wanting .... **Ceratosolens** Mayr.

12. Front tarsi 2- to 5-jointed, *not* reposing in a sulcus at the tip of the front tibiæ 13

    Front tarsi 1-jointed, reposing in a sulcus at the tip of the front tibiæ; claws small, almost straight.

    Legs four, the middle pair aborted; antennæ 3-jointed, compressed; head and thorax subquadrate. **Tetrapus** Mayr.

13. The usually large antennal fovea terminates posteriorly in a narrow or broad longitudinal slit; if it does not, then the transverse oval antennal fovea does not extend to the middle of the head 14

14. Body somewhat narrow; antennæ 3- to 6-jointed.

    Front tarsi 2 or 3-jointed 16

    Front tarsi 5-jointed.

    Thorax in outline trapezoidal; antennæ 6-jointed, with 3 ring-joints. **Pleistodontes** Saunders.

    Thorax not so shaped, either bell-shaped or ellipsoidal, antennæ 3- to 6-jointed 15

15. Thorax not oblong, in outline either ellipsoidal or bell-shaped; antennæ 3- to 6-jointed.

    Thorax ellipsoidal, slightly contracted at the sides before the middle; antennæ 6-jointed, with with one ring-joint and a 2-jointed club .... **Kradibia** Saunders.

    Thorax bell-shaped; antennæ 3- or 4-jointed, with one ring-joint. .... **Eupristina** Saunders.

16. Head about twice as long as wide; front tarsi 2-jointed; antennæ 6-jointed....... **Ceratosolens** Mayr.

    Head not or scarcely longer than wide, at the most not more than one and one half times as long as wide; front tarsi 3-jointed; antennæ 3-jointed.

    Head a little wider than long; tarsi of hind legs very long, more than twice longer than their tibiæ .... **Blastophaga** Gravenhorst.

    Head usually a little longer than wide, never wider than long; tarsi of hind legs short, not or only a little longer than tibiæ .... **Eisenia** Ashmead, gen. nov.

SUBFAMILY II. SYCOPHAGINÆ.

1883. Cynipidæ, Division II., Aploastomata, Saunders, Trans. Ent. Soc. London, 1883, p. 20.

This group was first correctly separated by Sir Sidney Saunders, who designated it as Division II., Aploastomata, in the family *Cynipidæ*. It has, however, nothing to do with the Cynipidæ, but forms a natural group of the genuine fig-insects. At present no species is known outside of the Asiatic and African faunæ.

The females belonging to the group are distinguished from those in the previous subfamily principally by the absence of mandibular appendages. The head, however, is also somewhat differently shaped, being flatter, with a broader frontal sulcus and no hook-like tubercle on the middle of the occiput, while the abdomen is more depressed and the ventral valve is not prominent.

The males are more easily recognized, being quite different from those in the *Agaoninæ* and the wingless males in the *Torymidæ*. The head is very long and narrow, while the abdomen is long, sessile, and gradually broadened towards apex, each lateral apical angle being furnished with a tubercle, or a long, thread-like organ.

The genus *Platyscapa* Motschulsky I do not know, but, judging from Motschulsky's description, it seems to be one of these insects, and I have included it in my table with the hope that it may be rediscovered, and its proper position in our system definitely settled.

TABLE OF GENERA.

1. Females 2
   Males 4
2. Postmarginal vein obsolete or nearly; maxillary palpi *with* rows of teeth along the under side 3
   Postmarginal vein well developed, longer than the stigmal vein; maxillary palpi *without* rows of teeth beneath.
   Antennæ 13-jointed, with 2 ring-joints, of which the second is rather large; hind tibiæ with rows of comb-like teeth at apex; stigmal vein not short .... **Sycophaga** Westwood (type *Cynips sycomori* Hasselquist).
   Antennæ 9-jointed (*teste* Motschulsky); hind tibiæ normal; stigmal vein short. **Platyscapa** Motschulsky (type *P. frontalis* Motsch.).
3. Antennæ 11-jointed; hind tibiæ *without* rows of teeth at apex .... **Crossogaster** Mayr (type *C. triformis* Mayr).
4. Apterous 5
   Winged.
   Postmarginal vein subobsolete; head with a large, deep triangular fovea anteriorly that extends posteriorly to the middle of the head; antennæ 11-jointed .... **Crossogaster** Mayr.
5. Head oblong, without a deep triangular fovea anteriorly; antennæ 3-jointed 6
   Head nearly quadrate, a little wider than long, with a deep, triangular fovea anteriorly.
   Antennæ 8-jointed, the scape thick, depressed; body broad .... **Crossogaster** Mayr.
6. Scape of antennæ about as broad as long; mandibles broad, 3-jointed; tarsal joints 2–4 wider than long; abdomen terminating in two long filaments, one on each apical angle ... **Sycophaga** Westwood.
   Scape of antennæ long, subclavate, more than twice longer than thick; mandibles conical, without teeth; tarsal joints 2–4, not wider than long; abdomen not terminating in two long filaments. **Apocrypta** Coquerel (type *A. perplexa* Coquerel).

Family LXI. TORYMIDÆ.

1833. Torymidæ, Family II. (partim) Walker, Ent. Mag., I., p. 115.
1846. Torymidæ, Family I., Walker, List Chalc. Brit. Museum, I., p. 14.
1848. Torymidæ, Family I., Walker, *opus. cit.*, II., p. 100.
1856. Torymoidæ, Familie XI., Förster, Hym. Stud., II., pp. 19, 23 and 43.
1875. Torymina, Tribus (partim) Thomson, Hym. Skand., IV., pp. 11 and 59.
1886. Toryminæ, Subfamily (partim), Howard, Ent. Amer., I., p. 198.
1897. Torymidæ, Family XLI., Ashmead, Proc. Ent. Soc. Washington, IV., p. 243.

This is a very large and most interesting family, approaching nearest, on one side, to the genuine fig-insects (Agaonidæ); on the other side exhibiting affinities that ally it to the *Chalcididæ*, and some forms in the *Miscogasteridæ* and the *Pteromalidæ*.

Many of the genera, especially in my subfamily *Idarninæ*, were included by Walker, Westwood and Mayr, among the *Agaonidæ*, a position not tenable. The genus *Podagrion* Spinola, too, on account of the swollen and dentate hind femora was placed by Mayr, Howard and others with the *Chalcididæ*. The swollen and dentate hind femora, although of great taxonomic importance, in themselves should not alone be depended upon to place genera and species. Many genera and species are now known with such femora that unquestionably belong to other families. In the family Cleonymidæ there is a whole subfamily with such hind femora and it would be absurd and most unnatural to classify it with the *Chalcididæ* on that account alone.

In establishing families many characters must be carefully considered, weighed and analyzed, and we should not be led astray by superficial resemblances or by characters common to many groups.

Six fairly well defined subfamilies have been recognized.

TABLE OF SUBFAMILIES.

1. Mesothoracic furrows not well defined, the scapulæ therefore scarcely or indistinctly separated; abdomen in ♀ conically pointed, the ovipositor not exserted. 6

   Mesothoracic furrows distinctly defined, the scapulæ therefore well separated; ovipositor always prominently exserted, most frequently very long. 2

2. Hind tibiæ with only *one* apical spur 5

   Hind tibiæ with *two* apical spurs.

   Posterior margin of the mesepisternum incised beyond the middle; metepimeron curved, dilated above the apex; posterior femora simple, neither armed with a tooth nor serrate. 3

   Posterior margin of the mesepisternum entire; posterior femora rarely simple, more or less swollen, serrate or armed with one or two teeth beneath, sometimes much swollen and armed with several teeth beneath 4

3. Stigmal vein always long; abdomen usually more or less depressed; if subcompressed the hypopygium is large and prominent; *males* frequently apterous, the head usually oblong, with a triangular fovea anteriorly in which lie the antennæ; abdomen short, never tubularly lengthened.

   Subfamily I. IDARNINÆ.

   Stigmal vein very short, the knob of same being sessile or subsessile; abdomen usually subcompressed, the hypopygium not prominent; *males* most frequently winged; if apterous, the head not oblong and without a triangular fovea anteriorly. . . . . Subfamily II. TORYMINÆ.

4. Hind femora not much swollen, as long as their tibiæ, beneath feebly serrate or armed with *one* or *two* teeth beyond the middle towards apex, their tibiæ straight; metanotum usually with a median carina, coarsely rugulose or punctate; stigmal vein not long, but still longer than in the *Toryminæ*, oblique and clavate . . . . Subfamily III. MONODONTOMERINÆ.

   Hind femora much swollen and armed with from *four* to *eight* teeth, their tibiæ arcuate; metanotum with a ʌ-shaped carina; stigmal vein short, the knob subsessile, similar to the *Toryminæ*.

   Subfamily IV. PODAGRIONINÆ.

5. Stigmal vein in front wings terminating in a large rounded or dilated knob or stigma, the basal nervure distinct, straight.......................................Subfamily V. MEGASTIGMINÆ.
6. Abdomen in ♀ conic-ovate or produced at apex, in ♂ oblong, usually with a peculiar sculpture in both sexes, the middle segments most frequently with transverse rows of pits or rounded punctures; stigmal vein very short...Subfamily VI. ORMYRINÆ.

SUBFAMILY I. IDARNINÆ.

1846. Agaonidæ, Family 6 (partim), Walker, List Chalc. Brit. Museum, I., p. 23.
1897. Idarninæ, Subfamily I., Ashmead, Proc. Ent. Soc. Washington, IV., p. 235.

All of the species composing this subfamily are found associated with the genuine fig-insects; they are either inquilinous or genuine parasites, as is the case in the *Cynipidæ* and the *Eurytomidæ*, and in at least another group in the Torymidæ, *i. e.*, the *Megastigminæ.*

The group comes nearest to the subfamily *Toryminæ,* agreeing with it closely in cephalic and thoracic characters, and in having two apical spurs on the hind tibiæ; but here the resemblance ceases, and it is easily separated by the difference in venation, shape of abdomen, etc.

The males are most frequently apterous, the head being long or oblong, with a triangular fovea anteriorly in which lie the antennæ, a character also found in the Agaonidæ; but the abdomen is short and never tubularly lengthened nor broadened at the apex, as in that family.

The females agree somewhat with the *Agaonidæ* in venation, but differ decidedly in cephalic, mandibular, and abdominal characters, the abdomen being either depressed, *without* a prominent ventral valve, or subcompressed with a prominent ventral valve, with a long ovipositor. From the *Toryminæ* they are at once distinguished by the *long* stigmal vein and the different shape of the abdomen.

TABLE OF GENERA.

1. Females.. 1
   Males.. 16
2. Abdomen normal, the last two segments not tubular.. 2
   Abdomen abnormal, the last two segments very narrow and produced into a kind of tube or tail, the ovipositor very long.. 3
3. Antennæ 10-jointed... 4
   Antennæ 13-jointed, with *three* ring-joints; mesonotum with distinct parapsidal furrows.
      Seventh abdominal segment very long, longer than the preceding segments united; scape of antennæ scarcely thrice the length of the pedicel......................**Philotrypesis** Förster. (type *Cynips caricæ* Hasselq.).
      Seventh abdominal segment hardly as long as the preceding segments united; scape of antennæ long, about four times as long as the pedicel **Sycoscaptella** Westw. (type *S. affinis* Westw.).
4. Prothorax long, conical; metathorax long; legs short and stout, the front femora incrassated. **Polanisa** Walker (type *Idarnes transiens* Walk.).

5. Scutellum *not* flat, usually convex or at least subconvex, and usually, but not always, *without* longitudinal grooved lines 6
   Scutellum flat and broad, quadrate, with *two* longitudinal grooved lines.
   Metallic; flagellum filiform, the joints of the funicle at least twice as long as thick; ocelli obtusely triangularly arranged .... **Idarnes** Walker (type *I. carme* Walker).
   Non-metallic; flagellum subclavate, the joints of the flagellum not or scarcely longer than thick; ocelli arranged nearly in a straight line.......... **Koebelea** Ashmead, g. nov. (type *K. australiensis* Ashm.).
6. Ovipositor *shorter* than the body and sometimes not at all prominent.......... 11
   Ovipositor *longer* than the body; funicle of antennæ 5-jointed.......... 7
7. Abdomen with the ventral segments normal, *not* widened downwards 8
   Abdomen with the ventral segments widened downwards.
   Hypopygium very prominent, plowshare shaped; antennæ 12-jointed, with 2 ring-joints. **Goniogaster** Mayr (type *G. variicornis* Mayr).
8. Mesothoracic furrows distinct, complete.......... 9
   Mesothoracic furrows *not* distinct, wanting posteriorly.
   Antennæ 11-jointed, with *one* ring-joint inserted much nearer to the front margin of the head than to the middle; stigmal vein long, nearly three fourths the length of the marginal. **Sycoryctes** Mayr (type *S. patellaris* Mayr).
9. Antennæ 12-jointed or less 10
   Antennæ 13-jointed, with *three* ring-joints inserted at an equal distance between the middle and the front margin of the head; stigmal vein less than one third the length of the marginal. **Trichaulus** Mayr (type *T. versicolor* Mayr).
10. Antennæ 12-jointed with *one* ring-joint; stigmal vein about half the length of the marginal. **Apocryptophagus** Ashmead, g. nov. (type *Chalcis ? explorator* Coquerel).
    Antennæ 9-jointed (teste Motschulsky); abdomen elliptic, much depressed, the ovipositor twice the length of the body.......... **Platyneura** Motschulsky (type *P. testacea* Motsch.).
11. Postmarginal vein distinct, always present 12
    Postmarginal vein wanting or never well developed 14
12. Ovipositor hidden 15
    Ovipositor always prominent or exserted 13
13. Antennæ 12-jointed with *two* ring-joints, the funicle 5-jointed, inserted near the clypeus, the joints of the flagellum fluted; body metallic; ovipositor about as long as the thorax and abdomen united or a little longer, and thickened towards apex. **Colyostichus** Mayr (type ♀ *C. longicaudis* Mayr, ♂ *Heteradrium longipes* Mayr).
    Antennæ 11-jointed with *one* ring-joint, the funicle 5-jointed, the club 3-jointed, the joints of the funicle hardly longer than thick; ovipositor scarcely as long as the abdomen, gradually thickened towards apex. **Heterandrium** Mayr (type ♂ *H. biannulatum* Mayr, ♀ *Colyostichus brevicaudis* Mayr).
14. Scutellum *with* two longitudinal grooved lines, the axillæ widely separated; ovipositor a little shorter than the abdomen.......... **Sycophila** Walker (type *S. decatomoides* Walk.).
    Scutellum *without* grooved lines, the axillæ nearly uniting at base of scutellum; ovipositor only slightly projecting.......... **Froggattia** Ashmead, g. nov. (type *F. polita* Ashm.).
15. Mesothoracic furrows indistinct, never complete; antennæ 9-jointed. **Micranisa** Walker (type *Idarnes pteromaloides* Walk.).

16. Tarsi 5-jointed.. 17
Tarsi 3- or 4-jointed.. 31
17. Apterous or with rudimentary wings.. 18
Winged.. 34
18. Antennæ inserted on the anterior margin of the head or far below its middle; clypeus not extending to the middle of the inner margin of eyes.. 19
Antennæ inserted on the middle of the face.. 30
19. Head anteriorly *with* a large, deep, triangular fovea from which originate the antennæ........... 20
Head anteriorly *without* such a fovea; wings entirely absent, *not* represented by filaments....... 25
20. Wings represented by *two* pairs of thread-like filaments.. 21
Wings represented by *one* pair of thread-like filaments or by bristles.. 22
21 Head oblong, not or scarcely wider than the thorax, the eyes minute; antennæ separated by a sharp carina; hind tarsi with the first joint dilated..............................**Philotrypesis** Förster.
Head large, oblong, slightly narrowed anteriorly, the hind margin sinuate, the hind angles rounded, setose; antennæ 8- or 9-jointed with 1 ring-joint, the scape large, clavate; mandibles large, porrect, curved, acute and entire at apex, but *within*, 3-dentate.
Tetranemopteryx Ashmead, g. nov. (type *Sycoscapter 4-setosa* Westw.).
22. Head oblong, the hind angles rounded, *not* acute.. 23
Head oblong-quadrate, the hind angles acutely produced, not rounded.. 24
23. Head large, oblong, broader than the thorax; antennæ 10-jointed, *with* 1 ring-joint inserted close together near the front margin of the head; mandibles porrect, stout and curved, the tips acute, entire, the inner margin with a tooth behind the middle.................. **Sycoscapter** Westwood (type *S. insignis* Westw.).
Head oblong-quadrate, sinuate posteriorly; antennæ 8- or 9-jointed, *without* a ring-joint, inserted close together near the mouth; mandibles porrect, falcate, the tips bidentate, the inner margin with a tooth near the base.............. **Sycoscapteridea** Ashmead, g. nov. (type *Sycoscapter monilifer*).
24. Head oblong, the sides anteriorly nearly straight, the front angles rounded, the hind angles acutely produced; antennæ 8-jointed (or 9-jointed with 1 ring-joint), inserted close together near the mouth; mandibles small, falcate, entire; wings represented by short filaments.
Sycoscapterella Ashmead, g. nov. (type *Sycoscapter anguliceps* Westw.).
25. Antennæ shorter, at the most 9-jointed, the joints closely united, inserted further from each other than to the sides of the head, most frequently with only 4 or 5 free joints.. 26
Antennæ longer, 10- or 11-jointed, with only the last three joints closely united, inserted near or not far away from the mouth border.. 27
26. Head between the clypeus and the sides concave; mandibles bidentate; labium and palpi wanting, in place is a membranous tube; antennæ composed of 4 free joints, of which the third is small, annular, transparent and membranous.. **Idarnes** Walker.
Head between the clypeus and side flat; mandibles 3- or 4-dentate; labium and labial palpi present, the palpi 1-jointed; tibiæ short, closely and thickly spinous; antennæ with 4 or 5 free joints.
Head depressed, wider than long, but not perfectly flat, more or less triangular, the angles rounded.. **Trichaulus** Mayr.
Head perfectly flat, longer than wide, trapezoidal; mandibles broad, 4-dentate within; antennæ 5-jointed, the scape flat, dilated towards apex...................**Koebelea** Ashmead.
27. Head more or less depressed; tarsi 5-jointed, the basal joint of hind tarsi often much compressed and with very long bristles.

Hind tarsi much longer than their tibiæ, the basal joint long 28

Hind tarsi not longer than their tibiæ, the basal joint short............................ 29

28. First joint of flagellum smaller than the second; mandibles bidentate; hind tibiæ *with* several very long bristles, the first joint two thirds the length of the tibia.................. **Colyostichus** Mayr.

First joint of flagellum much longer than the second; mandibles unidentate at apex; hind tibiæ *without* long bristles.. **Sycoryctes** Mayr.

29. First joint of the flagellum only a little longer than the second and not much longer than thick; man, dibles very long, strong and toothed within; hind tibiæ with short stiff bristles; all joints of tarsi slender; pronotum very large, quadrate, larger than the meso- and metanotum united.

Goniogaster Mayr.

30. Head large, sinuate anteriorly and posteriorly, and also with the lateral margins posteriorly incised so as to form a tooth just before the hind angles; wings represented by a pair of thread-like filaments; antennæ 10-jointed, with 2 ring-joints, inserted widely apart or laterly close to the eyes, the scape very large, dilated, quadrate above, rounded basally, and beneath at base deeply incised; mandibles robust, triangular, curved, the tips bifid, within towards base produced and tridentate.

Sycobiella Westwood (type *S. saundersii* Westw.).

Head large, transverse ellipsoidal, sinuate anteriorly, rounded posteriorly, the hind angles rounded; wings entirely wanting; antennæ 9-jointed, with 1 ring-joint, inserted on the middle of the face. much nearer together than to the inner margin of the eyes, the scape very large, dilated, clavate; mandibles long, porrect, the tips bidentate, dilated towards base, the dilation being tridentate.

Walkerella Westwood (type *W. timeraria* Westw.).

31. Tarsi 4-jointed; wings represented by thread-like filaments 32

Tarsi 3-jointed; wings wanting.. 33

32. Head oblong-quadrate, emarginate or sinuate anteriorly and posteriorly; ocelli absent; antennæ 8- or 9-jointed, without a ring-joint, inserted far above the middle of the face, the scape large, dilated, clavate; mandibles large, porrect, nearly as long as the head, curved, the tips bifid, the inner margin armed with a tooth near the middle or sometimes truncate.

Otetesella Westwood (type *O. digitata* Westw.).

33. Antennæ 9- to 11-jointed (the club sometimes 3 joints), with one ring-joint, shorter than the head and inserted close together near the mouth, the scape large, depressed, subclavate; mandibles small, acute, slightly curved, *without* teeth within........ **Sycoscaptella** Westwood (type *S. affinis* Westw.).

34. Postmarginal vein distinct, well developed 35

Postmarginal vein wanting or but slightly developed.. 39

35. Second joint of the funicle *not* shorter than the first.. 36

Second joint of the funicle very short, annular, much shorter than the first.

Antennæ 12-jointed, with 2 ring-joints; pronotum long.................. **Colyostichus** Mayr.

36. Antennæ 11–12-jointed, with 1 or 2 ring-joints, inserted much nearer to the mouth than to the middle of the head, the funicle 5-jointed 37

Antennæ 13-jointed, inserted below the middle of the head, the furrows in the joints of the flagellum not ending in little teeth.. 38

37. Postmarginal vein longer than the stigmal; mandibles not long, falcate, 2- or 3-dentate; antennæ 11–12-jointed, the club not much thicker than the funicle; pronotum subquadrate, a little wider at the middle than before or behind; scutellum large, subconvex, the parapsidal furrows very fine, but distinct.. **Colyostichus** Mayr.

Postmarginal vein *not* longer than the stigmal; mandibles very long, falcate, bidentate at apex; antennæ 11-jointed; pronotum very long, rounded in front; scutellum the parapsidal furrows distinct.......................... **Sycobia** Walker (type *S. bethyloides* Walk.).

38. Stigmal vein rather short, less than one third the length of the marginal; antennæ 13-jointed, with 2 ring-joints and a 6-jointed funicle.. **Trichaulus** Mayr.

39. Antennæ 13-jointed, with 2 ring-joints; mesonotum with distinct parapsidal furrows.

Pronotum quadrate, a little narrower than the mesonotum; scutellum with *two* grooved lines; abdomen oval, subdepressed, much shorter than the thorax, briefly petiolate, and terminating in an exserted penal sheath.. **Sycophila** Westwood.

Pronotum large, rounded anteriorly; scutellum *without* grooved lines; abdomen compressed, shorter than the thorax.. **Froggattia** Ashmead

Subfamily II. Toryminæ.

1840. Pteromalides, Subfamily (partim) Westwood, Intro. Mod. Class. Ins., II., Synop., p. 67.

1846. Torymidæ, Family 4 (partim) Walker, List. Chalcid. Brit. Museum, I., p. 14.

1871. Torymides, Subtribus (partim) Thomson, Hym. Skand., IV., pp. 59, 64.

1899. Toryminæ, Subfamily II., Ashmead, Proc. Ent. Soc. Washington, IV., p. 247.

The vast majority of the species falling in this group are parasitic on gall-inhabiting insects, belonging to the orders Hymenoptera and Diptera, although others are recorded as having been bred from Coleoptera, Lepidoptera, etc., and from the nests of bees and wasps.

I think it quite likely these latter records are erroneous, and that the Coleoptera, Lepidoptera, etc., had dipterous parasites from which the torymines came.

TABLE OF GENERA.

1. Females 2

Males 8

2. Antennæ 13-jointed, with only *one* ring-joint.. 3

Antennæ 13-jointed, with *two* ring-joints............... **Lochites** Förster (type *L. papaveris* Förster).

3. Scutellum *without* a cross-furrow before apex.. 4

Scutellum *with* a cross-furrow before apex.

Abdomen with second dorsal segment incised medially at apex.

Syntomaspis Förster (type *Torymus cyaneus* Boheman).

4. First joint of flagellum *not* abruptly narrower than the following; clypeus at apex truncate....... 5

First joint of flagellum abruptly narrower than the following; clypeus at apex subproduced.

Lioterphus Thomson (type *Torymus pallidicornis* Boheman).

5. Thorax not especially long, the pronotum not conically elongate.. 6

Thorax long, the pronotum much developed, conically elongate.

Abdomen with a distinct petiole, the body much compressed, shorter than the thorax, the ovipositor very long.................... **Ecdamua** Walker (type *E. macrotelus* Walker).

6. Mandibles 3-dentate; head not triangular; costal cell wide.. 7

Mandibles 2-dentate; head subtriangular, as viewed from in front; costal cell narrow.

Callimomus Thomson (type *C. scaposus* Thomson).

7. Prothorax not especially short; metathorax declivous, not largely punctate.
Torymus Dalman (type *Ichneumon bedeguaris* Linné).
Prothorax short, the metathorax abruptly declining, largely punctate; antennæ subclavate, the club lanceolate. .... **Torymoides** Walker (type *T. amabilis* Walker).
8. Antennæ 13-jointed, with only *one* ring-joint.......... 9
Antennæ 13-jointed, with *two* ring-joints.......... **Lochites** Förster.
9. Scutellum *without* a cross-furrow before apex.......... 10
Scutellum *with* a cross-furrow before apex.......... **Syntomaspis** Förster.
10. Mandibles 3-dentate; costal cell wide.......... 11
Mandibles 2-dentate; costal cell narrow.......... **Callimomus** Thomson.
11. Clypeus anteriorly normal, not produced.......... 12
Clypeus anteriorly subproduced medially.......... **Lioterphus** Thomson.
12. Thorax normal, the pronotum not especially long.......... 13
Thorax long, the pronotum elongate, conical.......... **Ecdamua** Walker.
13. Pronotum not especially short, the metathorax not largely punctate.......... **Torymus** Dalman.
Pronotum short, the metathorax abruptly declivous, largely punctate.......... **Torymoides** Walker.

Subfamily III. Monodontomerinæ.

1875. Torymides, Subtribus (partim) Thomson, Skand. Hym., IV., p. 59.
1899. Monodontomerinæ, Subfamily III., Ashm. Proc. Ent. Soc. Wash., IV., p. 247.

In this group the hind femora are more swollen than in the previous groups, while the lower edge is serrate or armed with one or two teeth, thus showing an approach to the *Podagrioninæ*, and through that subfamily to the *Leucospidinæ* and the *Chalcidinæ*.

Some of the species are parasitic upon hymenopterous and dipterous gall-making insects; others, belonging to the genera *Physothorax* and *Plesiostigma*, have been bred from fig-insects, while species belonging to the genera *Diamorus* and *Monodontomerus* are bred commonly from the nests of bees and wasps, and they are said to be parasites of these insects. In a single case, at least, I have *positive* evidence that *Monodontomerus* was bred from the puparium of a tachinid-fly found in the nest with the bee.

TABLE OF GENERA.

1. Females; ovipositor prominently exserted.......... 2
Males.......... 9
2 Hind femora beneath very finely denticulate and usually also with a single large tooth, rarely with 2 teth.......... 7
Hind femora beneath smooth, with 1 or 2 large teeth, some distance from the apex.......... 3
3. Scutellum *with* a cross furrow before the apex.......... 4
Scutellum *without* a cross furrow before the apex.
Abdomen short, not longer than the head and thorax united; stigmal vein very short.
Holaspis Mayr (type *Torymus militaris* Boheman).
Abdomen elongate. much longer than the head and thorax united; stigmal vein not short, oblique.......... **Websterellus** Ashmead (type *tritici*).

4. Abdomen with the hind margin of the first dorsal segment (or its flap) incised at the middle 5
Abdomen with the hind margin of the first dorsal segment straight, *not* incised.
Monodontomerus Westwood (type *M. obscurus* Westw.).
5. Funicle with 6 joints ; *head smooth or at most with sparse punctures* 6
Funicle with 7 joints ; head and thorax with large, thimble-like punctures.
Hind femora with a single tooth beneath towards apex .... **Diamorus** Walker (type *Torymus armatus* Boheman).
Hind femora with two teeth beneath toward apex......................... **Physothorax** Mayr (type *Diamorus variabilis* Mayr ♀, *Physothorax disciger* Mayr ♂).
6. Thorax delicately shagreened ; hind femora with a single indistinct tooth beneath towards apex.
Plesiostigma Mayr (type *P. bicolor* Mayr).
7. Eyes bare ; abdomen with the hind margin of the first dorsal segment incised ; hind femora usually serrate or with one or two teeth beneath towards apex 8
Eyes hairy ; abdomen with the hind margin of the first dorsal segment straight, not incised ; hind femora sometimes without a tooth .... **Oligosthenus** Förster (type *Ichneumon stigma* Fabr...
8. Front femora much swollen, the pronotum longer than the mesonotum ; antennæ with *two* ring-joints.
Plesiostigmodes Ashmead, g. nov. (type *P. brasiliensis* Ashm.).
Front femora normal, the pronotum shorter than the mesonotum ; antennæ with *one* ring-joint.
Hind femora serrate and usually with one tooth beneath ; stigmal vein short but distinct, the knob always petiolate ; thorax without thimble-like punctures...... **Cryptopristus** Förster (type *Torymus caliginosus* Walk.).
Hind femora feebly serrate beneath without a tooth ; stigmal knob sessile, the stigmal vein not developed ; thorax with small, thimble-like punctures....... **Hemitorymus** Ashmead, g. nov. (type *H. thoracicus* Ashm.).
9. Apterous or with rudimentary wings 16
Winged.
Hind femora beneath towards apex finely serrate and usually also with one or two teeth.... 13
Hind femora beneath smooth with *one* large tooth some distance from the apex........... 10
10. Scutellum *without* a cross-furrow before apex.. 11
Scutellum *with* a cross-furrow before apex.. 12
11. Stigmal vein very short ; abdomen concave above.................................. **Holaspis** Mayr.
Stigmal vein not short, oblique ; abdomen not concave above................. **Websterellus** Ashmead.
12. Hind margin of the first dorsal segment incised at the middle................................ 13
Hind margin of the first dorsal segment straight, not incised at the middle.
Monodontomerus Westwood.
13. Head smooth, or at the most with sparse punctures ; funicle 6-jointed........................ 14
Head and thorax with rather large, thimble-like punctures.
Hind femora with a single large tooth ; stigmal vein not short, the knob moderately large ; hind tarsi very long, the first joint long.................................. **Diamorus** Walker.
Hind femora with two rather small teeth (normal form) ; stigmal vein very short, the knob very small ; hind tarsi not especially long, the first joint not longer than 2 and 3 united.
Physothorax Mayr.
14. Eyes bare ; hind margin of first abdominal segment usually incised medially.................... 15
Eyes hairy ; hind margin of the first abdominal segment straight, not incised ; hind femora usually without a tooth .... **Oligosthenus** Förster.

15. Front femora much swollen, the hind femora finely serrate beneath ; antennæ with 2 ring-joints.
Plesiostigmodes Ashmead, g. nov. (type *P. brasiliensis* Ashm.).
Front femora normal, the hind femora finely serrate beneath and often with a tooth ; antennæ with 1 ring-joint.
Stigmal vein distinct, its knob always petioled........................**Cryptopristus** Förster.
Stigmal vein very short, its knob sessile...........................**Hemitorymus** Ashmead.
16. Antennæ inserted close together.
Antennæ 2-jointed, the second clavate (dimorphic form)....**Plesiostigma** Mayr, *Nannocerus* Mayr.
Antennæ 4- to 7-jointed ; thorax not depressed ; hind femora with 2 teeth beneath towards apex ; hind tibiæ with spines only at base of tarsi (dimorphic form)..........**Physothorax** Mayr.

Subfamily IV. Podagrioninæ.

This group in having the hind femora greatly swollen and dentate beneath, with the hind tibiæ curved, resembles the *Chalcididæ*, but otherwise, in the structure of head, side pieces of the thorax, coxæ, and in venation, it is a genuine Torymid, and I have here removed it from the *Chalcididæ*, where late authorities have placed it, to a place in this family.

The genus *Podagrion* is parasitic in the egg-cases of the orthopterous family *Mantidæ*.

TABLE OF GENERA.

Stigmal vein not so short, the knob petiolate ; tarsal joints 2–5 very short, transverse, the first joint long ; hind femora armed with 4 teeth...................**Pachytomus** Westwood (type *P. klugianus* Westw.).
Stigmal vein very short, the knob subsessile ; tarsal joints 2–5 not short ; hind femora armed with from 6 to 8 teeth..**Podagrion** Spinola (type *P. splendens* Spinola).

Subfamily V. Megastigminæ.

1875. Megastigmides, Subtribus, Thomson, Skand. Hym., IV., p. 59.
1899. Megastigminæ, Subfamily IV., Ashmead, Proc. Ent. Soc. Washington, IV., p. 246.

The species falling in this subfamily are easily recognized by the large circular or rounded knob of the stigmal vein.

Species of the genus *Megastigmus* are bred commonly from hymenopterous and dipterous gall-makers (*Cynipidæ* and *Cecidomyiidæ*) and also from the seed capsules of various trees and plants. The group is, therefore, phytophagous as well as parasitic. *Megastigmus spermatotr_phus* Wachtl was bred from the seed of the Douglas spruce, *Pseudotsuga douglasii.* It is identical with *M. pinus* Parfitt, also bred from the seed of a pine and described thirty-six years earlier.

TABLE OF GENERA.

1. Head and thorax smooth or transversely wrinkled or aciculate ; mandibles 3-dentate............... 2
Head and thorax neither smooth nor transversely wrinkled or aciculate, but sparsely or very finely punctate ; mandibles 4-dentate.

Abdomen distinctly petiolate, the petiole the length of the metathorax, the body short, elliptical, not compressed, shorter than the thorax; scutellum *without* a cross-furrow before tip.
Odopoia Walker (type *O. atra* Walker).

Abdomen subsessile, the body elongate, subcompressed, the length of the thorax; scutellum *with* a cross-furrow before apex....... **Bootania** Dalla Torre (type *Metamorpha leucospoides* Walker).

2. Head seen from in front a little wider than long, the ocelli placed in a slight curved line; scutellum with a cross-furrow before apex............ **Megastigmus** Dalman (type *Ichneumon dorsalis* Fabricius.

Subfamily VI. Ormyrinæ.

1856. Ormyroidæ, Familie X., Förster, Hym. Stud., II., pp. 19, 22 and 24.

1875. Ormyrides, Subtribus, Thomson, Skand. Hym., IV., p. 100.

1899. Ormyrinæ, Subfamily V., Ashmead, Proc. Ent. Soc. Wash., IV., p. 247.

Dr. Arnold Förster was the first to separate this group from other Torymids. It is a very distinct and compact subfamily, agreeing with the subfamily *Toryminæ* in venation and in pleural and pedal characters, but otherwise it is totally different from it and the others. The females are easily recognized by the elongate, pointed, or conically produced abdomen, non-prominent ovipositor, and by its peculiar sculpture; the males by the oblong oval shape of the abdomen, as well as by the sculpture.

It shows some affinity with the *Eurytomidæ*, and particularly with my tribe *Rileyini*, in the shape of the pronotum, and in antennal and abdominal peculiarities.

All are bred from hymenopterous and dipterous gall-insects, belonging principally to the families *Cynipidæ* and *Cecidomyiidæ;* only a few species have been described.

Only three genera are known distinguished as follows:

TABLE OF GENERA.

1. Males; abdomen oblong, depressed 4

Females; abdomen long, conically pointed and more or less compressed, especially towards the apex, the ovipositor never prominent.. 2

2. Abdomen *without* a peculiar sculpture, normal 3

Abdomen *with* a peculiar sculpture, and some of the segments with two rows of pits or deep punctures.

No large, coarse punctures at base of middle abdominal segments; antennæ with *one* ring-joint .... **Monobæus** Förster (type *M. cingulatus* Först.).

With large, coarse punctures at base of middle abdominal segments; antennæ with *two* ring-joints .... **Ormyrus** Westwood (type *O. punctiger* Westw.).

3. Abdomen finely punctate; antennæ with *three* ring-joints. **Tribæus** Förster (type *T. punctulatus* Först.).

4. Abdomen *without* a peculiar sculpture.. 5

Abdomen *with* a peculiar sculpture.

Antennæ with *one* ring-joint.. **Monobæus** Förster.

Antennæ with *two* ring-joints... **Ormyrus** Westwood.

5. Antennæ with *three* ring-joints.. **Tribæus** Förster.

Family LXII. CHALCIDIDÆ.

1830. Chalcidæ, Family (partim), Leach, Edinb. Encyc., IX., p. 144.
1840. Chalcidæ, Subfamily I. (partim), Westwood, Intro. Mod. Class. Ins., I., p. 166, Synop., p. 65.
1846. Chalcididæ, Family II. (partim), Walker, List Chalc. Brit. Mus., I., p. 2.
1856. Chalcidoidæ, Familie II., Förster, Hym. Stud., II., pp. 18, 21 and 29.
1875. Chalcidina Tribus, Thomson, Hym. Skand., IV., pp. 11, 12.
1886. Chalcidinæ, Subfamily (partim), Howard, Ent. Amer , I., p. 197.
1897. Chalcididæ, Family LXII., Ashmead, Proc. Ent. Soc. Washington, IV., p. 245.
1900. Chalcididæ, Family LXII., Ashmead, Proc. U. S. National Museum, XXIII., p. 202.

This family, although allied to the *Torymidæ* and to the *Eurytomidæ*, is very distinct in many particulars; by the usually very long, subcylindrical hind coxæ, the greatly swollen hind femora, usually dentate or serrate beneath, by the strongly arcuate hind tibiæ which are usually obliquely truncately produced at apex, so that the tarsi appear to be attached a little before the tips, and by pronotal and abdominal differences.

The group is most extensively represented in South America, where many genera and many species have been discovered.

Two subfamilies have been recognized, distinguishable as follows:

TABLE OF SUBFAMILIES.

Front wings longitudinally folded; ovipositor curving upwards and backwards over the dorsum of the abdomen.......... Subfamily I. Leucospidinæ.

Front wings not folded; ovipositor when prominent, straight, not curving over the dorsum of the abdomen.......... Subfamily II. Chalcidinæ.

Subfamily I. Leucospidinæ.

1833. Leucopsidæ, Family, Walker, Ent. Mag., II., p. 13.
1839. Leucospidæ, Family XV., Haliday, Hym. Synop., p. ii.
1846. Leucospidæ, Family I., Walker, List Chalc. Brit. Museum, I., p. 1.
1856. Leucospoidæ, Family I., Förster, Hym. Stud., II., pp. 18, 20 and 29.
1886. Leucospinæ, Subfamily, Howard, Ent. Amer., I., p. 197.
1897. Leucospidinæ, Subfamily I., Ashmead, Proc. Ent. Soc. Wash., IV., p. 235.

Dr. von Dalla Torre, in his Catalogus Hymenopterorum, Vol. V., has incorrectly credited this subfamily to Förster; it should be credited to Walker, who designated it as a family as early as 1833.

The group is a natural one, and is very distinct from the other groups of the *Chalcididæ*, in habits, in abdominal peculiarities — the ovipositor being curved forward

over the dorsum of the abdomen, often reaching to the scutellum, and in having the wings longitudinally folded as in the *Vespidæ*, *Eumenidæ* and in the Diapriid genus *Galesus*.

The group is parasitic in the nest of bees and the longitudinal fold in the wings is significant, for the leucospid is thus enabled to crawl into the nest of a bee without seriously disturbing its contents.

The group was monographed by Dr. August Schletterer in 1890, in the Berliner Entomologische Zeitschrift, vol. 35. This work should be in the hands of all students who desire to study these insects.

TABLE OF GENERA.

1. Frons anteriorly *not* cornuted; hind margin of the head not curved inwardly; third joint of antennæ at least as long as the second, usually, however, distinctly longer; pronotum anteriorly as broad as behind; scutellum never cordate 2

   Frons anteriorly bicornuted; hind margin of the head curved inwardly; third joint of antennæ smaller than the following; pronotum narrowed anteriorly; scutellum cordate.

   Marres Walker (type *M. dicomas* Walker).

2. Abdomen more or less compressed, rounded or vertically angular posteriorly, but never pointed; ovipositor extends from beneath the venter and curves over the tip of the abdomen backwards, reposing upon the dorsum, sometimes extending to the scutellum; hind coxæ without a tooth above; maxillary palpi distinct, 4-jointed 3

   Abdomen more fusiform and not distinctly compressed, the paunch followed to the dorsum, with a long channel and with the apex pointed; ovipositor confined to the under surface of the abdomen and not extending further than to its tip; hind coxæ with a strong erect tooth above; maxillary palpi 3-jointed, short and slender.......... **Polistomorpha** Westwood (type *P. surinamensis* Walker).

3. Front coxæ not especially long, much shorter than their femora, the tibiæ as long as the femora; middle tibiæ without a tooth at apex; hind tibiæ at apex normal, with 2 spurs.

   Leucospis Fabricius (type *L. dorsigera* Fabricius).

   Front coxæ very elongate, nearly as long as their femora, the tibiæ shorter than the femora; middle tibiæ with a tooth at apex; hind tibiæ curved and acutely produced into a spine at apex.

   Exoclænus Shipp (type *Leucospis anthidioides* Westw.).

Subfamily II. Chalcidinæ.

1835. Chalcididæ, Family, Walker, Ent. Mag., II., p. 20.
1839. Chalcididæ, Family XVI., Haliday, Hym. Synop., p. ii.
1856. Chalcidoidæ, Familie, Förster, Hym. Stud., ii., p. 29.
1897. Chalcidinæ, Subfamily II., Ashmead, Proc. Ent. Soc. Wash., IV., p. 247.

In having the hind femora greatly swollen and usually dentate or serrate, this subfamily agrees with the *Leucospidinæ*, but differs in having the front wings not folded longitudinally in repose, by having a much smaller pronotum, and quite a different shaped abdomen, the ovipositor, when prominent, being straight and never curved forward over the dorsum.

I have divided it into four tribes, which may be distinguished by the characters made use of in the following table :

TABLE OF TRIBES.

1. Abdomen sessile 2
   Abdomen petiolate.......... 3
2. Postmarginal vein wanting or only slightly developed, the stigmal vein very short, sometimes absent; antennæ inserted close to the mouth border.......... 5
   Postmarginal vein always well developed, the stigmal vein rarely very short.
   Antennæ inserted near the middle of the face, or at least always *above* an imaginary line drawn from the base of the eyes ....Tribe I. Chalcidini.
   Antennæ inserted near the mouth border, or always *below* an imaginary line drawn from the base of the eyes..........Tribe IV. Haltichellini (partim).
3. Antennæ inserted near the mouth border, or always *below* an imaginary line drawn from the base of the eyes 5
   Antennæ inserted near the middle of the face, or always *above* an imaginary line drawn from the base of the eyes 4
4. Postmarginal vein very long ; ovipositor if prominent not very slender, the eighth dorsal segment often produced into a long compressed stylus..........Tribe II. Smicrini.
5. Head normal, *not* cornuted.
   Abdomen petiolate..........Tribe III. Chalcitellini.
   Abdomen sessile .... Tribe IV. Haltichellini.
   Head abnormal, deeply excavated in front, cornuted ; abdomen petiolate or subpetiolate. Tribe V. Dirhinini

TRIBE I. *Chalcidini.*

This group is distinguished by the sessile abdomen and by having the antennæ inserted near the middle of the face or at least never *below* an imaginary line drawn from the base of the eyes.

Through the genus *Acanthochalcis* it is related to the subfamily *Leucospidinæ*, while in the abdominal peculiarities of most of the species the group is much closer allied to the tribe *Haltichellini.*

Most of the genera attack principally lepidopterous insects in the pupal stage. *Phasgonophora*, however, and probably also the allied genera *Trigonura*, *Stypiura*, etc., prey upon wood-boring coleopterous larvæ.

TABLE OF GENERA.

1. Females.......... 2
   Males.......... 12
2. Scutellum normal, unarmed, although sometimes with a slight median depression towards apex; if with a slight elevated plate behind, the same is entire, rarely subemarginate 3
   Scutellum posteriorly armed, emarginate or produced.......... 8
3. Abdomen not ending in a long, distinct ovipositor, although the eighth dorsal segment is often much produced, long and compressed, resembling a stylus and enclosing the ovipositor.......... 4

Abdomen ending in a long, distinct ovipositor, which is sometimes as long as the whole body.
Acanthochalcis Cameron (type *A. nigrescens* Cameron).

4. Abdomen much produced at apex, the eighth dorsal segment long, compressed, resembling a stylus 5
Abdomen normal, subglobose or ovate, the eighth dorsal segment never very long 11

5. Scutellum normal, rounded behind, if with a slight plate behind the same is entire, not emarginate 6
Scutellum terminating in a projection or plate posteriorly which is usually emarginate 8

6. Abdomen at base rounded, not truncate 7
Abdomen at base truncate, the truncature bounded by a carina.
Antennæ 13-jointed, the flagellum long, slender, filiform .... **Phasgonophora** Westwood (type *P. sulcata* Westw.).

7. Eighth dorsal abdominal segment produced into a triangular stylus, the second segment (or the first body segment) occupying only about one third the length of the body; antennæ 11-jointed, subclavate .... **Trigonura** Sichel (type *T. crassicauda* Sichel).
Eighth dorsal abdominal segment very long, compressed but not triangular, the second segment variable, usually, however, occupying about half the length of the body; antennæ 11-jointed, filiform, tapering toward tips .... **Thaumatelia** Kirby (type *Chalcis separata* Walker).

8. Scutellum with a short, thick projection behind 9
Scutellum ending in a raised emarginate or bidentate plate.
Metathorax unarmed 10
Metathorax with two very prominent projections on each side, and very hairy.
Abdomen with the eighth dorsal segment produced into a long stylus; antennæ 12-jointed.
Megalocolus Kirby (type *Halticella ducator* Walker).

9. Metathorax with two teeth on each side; hind femora armed with 7 or 8 teeth beneath.
Pseuedocholcis Kirby (type *Halticella declarator* Walk.).
Metathorax produced and excised medially; hind femora unarmed...... **Oxycoryphe** Kriechbaumer. (type *O. subænea* Kriechb.).

10. Marginal vein very short, the postmarginal and the stigmal veins abnormally long; hind femora with numerous small teeth beneath (about 14); abdomen long, conically produced.
Larradomorpha Stadelman (type *L. insignis* Stadelm.).
Marginal vein long, the stigmal vein normal, not very long.
Hind femora armed with one long tooth followed by 6 or 7 smaller teeth; antennæ 11-jointed.
Stypiura Kirby (type *Chalcis conigastra* Perty).
Hind femora with numerous depressed punctures, and with about 6 large teeth beneath; antennæ 13-jointed.................................. **Epitelia** Kirby (type *Chalcis stylata* Walker).

11. Antennæ 13-jointed, with 1 ring-jointed, rather short; hind femora armed with many minute teeth beneath.................................. **Chalcis** Fabricius (type *Vespa minuta* Linné).

12. Scutellum posteriorly unarmed, normal 13
Scutellum posteriorly armed, emarginate or produced.. 16

13. Abdomen at base rounded, not truncate.. 14
Abdomen at base truncate, the truncature bounded by a carina .... **Phasgonophora** Westwood.

14. Hind angles of metathorax rounded, not prominent.. 15
Hind angles of metathorax prominent, acute, clothed above with usually a silvery white pubescence; thorax coarsely punctate, the abdomen punctate or at least not entirely impunctate; antennæ 11-jointed, the flagellum filiform... **Acanthochalcis** Cameron.

15. Antennæ 13-jointed, with one ring-joint.......... 19
Antennæ 11-jointed, with one ring-joint.
Marginal vein about four times the length of the stigmal vein; hind femora with 6 moderately large teeth beneath; antennæ 11-jointed, the flagellum filiform, the first joint shorter than the scape.......... **Trigonura** Sichel.
Marginal vein long, four or more times longer than the stigmal vein; hind femora with 8 teeth beneath; antennæ 11-jointed, the flagellum long, filiform, the first joint longer than the scape.
Thaumatelia Kirby.
16. Scutellum with a short thick projection behind; metathorax emarginate or armed.......... 17
Scutellum ending in a raised emarginate or bidentate plate; metathorax unarmed.......... 18
17. Metathorax produced and excised medially; hind femora unarmed...... **Oxycoryphe** Kriechbaumer.
Metathorax usually with two teeth on each side (rarely normal); hind femora armed with 7 or 8 teeth beneath.......... **Pseudochalcis** Kirby.
18. Antennæ 11-jointed; marginal vein long, the stigmal vein normal, not very long.
Hind femora armed with one large tooth, followed by 6 or 7 smaller teeth.... **Stypiura** Kirby.
Hind femora with numerous depressed punctures and with 6 large teeth....... **Epitelia** Kirby.
Antennæ (?) 12- or 13-jointed; marginal vein *very* short, the stigmal vein abnormally long; hind femora with numerous small teeth beneath (about 14).......... **Larradomorpha** Stadelman.
19. Hind femora armed with many small teeth beneath.......... **Chalcis** Fabricius.

Tribe II. *Smicrini.*

This tribe approaches nearest to the tribe *Chalcidini*, but is at once separated from it by having the abdomen always distinctly petiolate, never sessile, and by having the hind coxæ abnormally long, as compared with those in the *Chalcidini*.

The species are principally parasitic upon lepidopterous larvæ, although some will attack other insects.

TABLE OF GENERA.

1. Females.......... 2
Males.......... 23
2. Middle tibiæ *without* an apical spur.......... 3
Middle tibiæ *with* an apical spur.......... 4
3. Antennæ 12- or 13-jointed; thorax black; abdomen ovate or conic-ovate, the second segment shorter, not occupying nearly the whole surface; hind femora armed with many minute teeth.
Smicra Spinola (type *Chalcis sispes* Fabr.).
Antennæ 14-jointed; thorax mostly yellow or marked with yellow, never wholly black; abdomen conically produced, the second segment large, occupying most of the surface; hind femora armed with 6 teeth of moderate size.......... **Epitranus** Walker (type *E. fulvescens* Walk.).
4. Hind femora armed with one large or moderately large tooth near base followed by many small or minute teeth, 10 or more in number.......... 5
Hind femora armed with from 3 to 9 teeth, the teeth usually *large*.......... 14
5. Metathorax unarmed.......... 6
Metathorax armed with from two to four teeth or projections.......... 10
6. Scutellum at apex simple, *unarmed*, *without* an elevated plate, teeth or spines.......... 7
Scutellum at apex armed, *with* an elevated plate, which is usually emarginate or bidentate....... 13

7. Metathorax *without* lateral teeth or projections... 8
Metathorax *with* lateral teeth or projections.. 10
8. Abdomen produced, the eighth segment in female greatly lengthened into a long compressed stylus; antennæ 13-jointed......................**Eustypiura** Ashmead, gen. nov. (type *E. bicolor* Ashm.).
Abdomen conic-ovate or fusiform, the eighth segment in female normal or nearly, not produced into a stylus; antennæ 13-jointed.
Petiole of abdomen very long and slender, as long as the thorax or nearly, or at least twice as long as the metathorax.. 9
Petiole of abdomen usually short and stout, never very long or slender; scape of antennæ normal, not extending beyond the ocelli **Spilochalcis** Thomson (type *Chalcis xanthostigma* Dalm.).
9. Scape of antennæ abnormal, very long and usually clavate, extending far above the ocelli, its apex beneath sometimes excavated and enclosing the base of the flagellum; abdominal petiole slender and of a uniform thickness throughout **Ceratosmicra** Ashm., gen. nov. (type *C. petiolata* Ashm.).
Scape of antennæ slender, cylindrical, not or scarcely reaching beyond the ocelli; abdominal petiole thickest at the middle, tapering off towards each end...............**Sayiella** Ashmead, gen. nov. (type *Smicra debilis* Say.).
10. Scutellum normal, unarmed 11
Scutellum at apex bidentate or with an emarginate plate or ridge.
Metathorax quadridentate (two teeth on each side of the petiole); body of abdomen short ovate, the petiole shorter than the thorax; antennæ 13-jointed, the flagellum filiform, clothed with a dense, short pubescence, the scape short, subcompressed.**Xanthomelanus** Ashmead, gen. nov. (type *Chalcis dimidiata* Fabr.).
11. Metathorax bidentate (one tooth on each side of the petiole); thorax never wholly black; antennæ 13-jointed 12
Metathorax quadridentate (two teeth on each side of the petiole); thorax sometimes wholly black; scape of antennæ long, extending beyond the ocelli.
Thorax wholly black; body of abdomen ovate, the petiole variable in length, usually long and slender, but shorter than the thorax; antennæ 13-jointed, the flagellum filiform, the scape at tip beneath not excavated... **Melanosmicra** Ashmead, gen. nov. (type *M. immaculata* Ashm.).
Thorax yellow or yellow marked with black; body of abdomen usually conical, the petiole long; antennæ 13-jointed, the scape at apex beneath excavated. **Ceratosmicra** Ashmead (partim).
12. Scape of antennæ normal; body of abdomen in female fusiformly pointed or conic-ovate, the petiole very short, not or rarely longer than thick...........................**Spilochalcis** Thomson (partim).
Scape of antennæ usually long and extending much beyond the ocelli; body of abdomen ovate, the petiole very long and slender, as long or nearly as the thorax.... **Mischosmicra** Ashmead, gen. nov. (type *M. Kahlii* Ashm.).
13. Metathorax normal or with one small tooth on each side of the petiole; abdomen variable, subglobose, conic-ovate or fusiform, but rarely ending in a stylus; antennæ 13-jointed. **Spilochalcis** Thomson (partim).
14. Antennæ 13- or 14-jointed 15
Antennæ 12-jointed.
Metathorax posteriorly quadridentate..........**Thaumapus** Kirby (type *Smicra decora* Walk.).
15. Antennæ 13-jointed 16
Antennæ 14-jointed; hind coxæ usually with a leaf-like expansion at apex, their femora armed with large or moderate sized teeth .... **Epinæus** Kirby (type *Smicra dux* Walker).

16. Hind femora armed with 8 large teeth or less.. 17
Hind femora armed with 9 moderately large teeth.
Scutellum sometimes unarmed but usually ending in a bidentate plate.
Enneasmicra Ashmead, gen. nov. (type *Smicra exinamius* Walk.).

17. Hind femora armed with 7 large teeth or less.. 19
Hind femora armed with 8 large or moderate sized teeth (the 8th tooth sometimes reduced in size or followed by one or two minute teeth, or the 6th tooth is tridentate at apex).
Mesonotum *with* distinct parapsidal furrows, or at least distinct anteriorly................ 18
Mesonotum *without* distinct parapsidal furrows.
Abdomen fusiformly pointed, the petiole very short; hind femora about $2\frac{1}{2}$ times as long as wide............................**Protoceras** Kirby (type *Smicra leucotelus* Walk.).

18. Scutellum at apex usually ending in an emarginate or bidentate plate; abdomen in female lanceolate or conically produced; the 8th segment often long, styliform.
Octosmicra Ashmead, gen. nov. (type *O. laticeps* Ashm.).

19. Hind femora armed with 6 large teeth or less.. 20
Hind femora armed with 7 large teeth, the seventh usually much reduced in size.
Abdomen in female conically produced or fusiform, the 8th segment sometimes styliform or produced into a stylus, the petiole not short; mandibles in ♀ bi- in ♂ tri-dentate.
Heptasmicra Ashmead, gen. nov. (type *Smicra obliterata* Walk.).

20. Hind femora armed with 5 large teeth or less 21
Hind femora armed with 6 large teeth (the 6th tooth sometimes broad and at apex 3-dentate).
Metathorax armed with two triangular teeth and a lamina or plate just behind the insertion of the hind wings, the latter extending slightly over the metapleura, the sculpture coarse; teeth of hind femora short and stout......... **Diplodontia** Ashmead (type *Smicra carolina* Ashm.).
Metathorax usually, but not always, armed with two, not very prominent, teeth, but *without* the lamina or plate behind the insertion of the hind wings, the sculpture alveolate; teeth of hind femora large, long.
Abdomen in female subglobose or short ovate, the petiole always more than twice longer than thick.......................**Metadontia** Ashmead (type *Smicra montana* Ashm.).
Abdomen in female lanceolate or fusiformly produced, longer than the head and thorax united, the petiole very short, not longer than thick.
Hexasmicra Ashmead, gen. nov. (type *Smicra transversa* Walk.).

21. Hind femora armed with 4 large teeth or less.. 22
Hind femora armed with 5 large teeth.
Eyes very large, occupying nearly the whole sides of the head; mandibles broad, 3-dentate; scutellum usually ending in an emarginate or bidentate plate; metathorax alveolate.
Pentasmicra Ashmead, gen. nov. (type *P. brasiliensis* Ashm.).

22. Hind femora with 4 large teeth; metathorax usually with teeth or projections, rarely unarmed; plate at apex of scutellum bidentate or broadly emarginate; abdomen ovate or conic-ovate, rarely fusiform, the eighth segment in female never very long........**Tetrasmicra** Ashmead, gen. nov (type *Smicra concitata* Walk.).
Hind femora with 3 large teeth...............**Trismicra** Ashmead, g. nov. (type *S. contracta* Walk.).

23. Middle tibiæ *without* an apical spur.. 24
Middle tibiæ *with* an apical spur.. 25

24. Antennæ 12- or 13-jointed; thorax black; hind femora armed with many minute teeth..**Smicra** Spinola.
Antennæ 14-jointed; thorax yellow or yellow marked with black; hind femora armed with 6 teeth.
Epitranus Walker.

25. Hind femora armed with one large tooth near base followed by many small or minute teeth, from 10 to 20 or more........ 26
Hind femora armed with from 3 to 9 large teeth........ 30

26. Metathorax armed with from 2 to 4 teeth or projections........ 29
Metathorax unarmed.
Scutellum at apex unarmed, without an emarginate or bidentate plate........ 27
Scutellum at apex armed with an emarginate or bidentate plate.

27. Abdominal petiole very long and slender, as long as the thorax or nearly........ 28
Abdominal petiole usually short and stout, or at least never very long nor very slender.
Pronotum anteriorly rounded or sloping, not acute; petiole carinate. **Eustypiura** Ashmead.
Pronotum anteriorly acute; petiole not carinate........**Spilochalcis** Thomson.

28. Scape of antennæ abnormal, long and clavate, extending far above the ocelli. **Ceratosmicra** Ashmead.
Scape of antennæ slender, cylindrical, not or only slight extending above the ocelli. **Sayiella** Ashmead.

29. Metathorax bi-dentate; a tooth on each side of the petiole.
Scape of antennæ normal; abdominal petiole not very long nor slender.
Spilochalcis Thoms. (partim).
Scape of antennæ usually long and slender, extending much beyond the ocelli; abdominal petiole very long and slender, as long or nearly as long as the thorax.
Mischosmicra Ashmead.
Metathorax quadridentate; two teeth on each side of the petiole.
Scutellum at apex, bidentate or with an emarginate plate........ **Xanthomelanus** Ashmead.
Scutellum at apex normal, unarmed.
Thorax wholly black; scape of antennæ normal, petiole of abdomen normal.
Melanosmicra Ashmead.
Thorax yellow or yellow marked with black; scape of antennæ abnormal; petiole of abdomen very long.
Scape long and clavate, excavate at apex beneath, extending far above the ocelli.
Ceratosmicra Ashmead.
Scape slender, cylindrical and extending only slightly beyond the ocelli.
Sayiella Ashmead.

30. Antennæ 13- or 14-jointed........ 31
Antennæ 12-jointed; metathorax quadridentat........ **Thaumapus** Kirby.

31. Antennæ 13-jointed........ 32
Antennæ 14-jointed.
Hind femora armed with large or moderate-sized teeth........ **Epinæus** Kirby.

32. Hind femora armed with 8 large teeth or less........ 33
Hind femora armed with 9 moderately large teeth........**Enneasmicra** Ashmead.

33. Hind femora armed with 7 large teeth or less........ 34
Hind femora armed with 8 large teeth.
Mesonotum *without* distinct parapsidal furrow........ **Protoceras** Kirby.
Mesonotum *with* distinct parapsidal furrows........ **Octosmicra** Ashmead.

34. Hind femora with 6 large teeth or less........ 35
Hind femora with 7 large teeth........**Heptasmicra** Ashmead.

35. Hind femora armed with 5 large teeth or less.. 36
Hind femora armed with 6 large teeth.
Metathorax armed with two triangular teeth or projections and a lamina or plate just behind the insertion of the hind wings that extends slightly over the mesopleura; teeth of hind femora short and stout...**Diplodontia** Ashmead.
Metathorax sometimes armed with two teeth, sometimes unarmed but always without the lamina or plate.
? ♂ unknown...**Metadontia** Ashmead.
? ♂ unknown...**Hexasmicra** Ashmead.
36. Hind femora armed with 4 large teeth or less.. 37
Hind femora armed with 5 large teeth.....................................**Pentasmicra** Ashmead.
37. Hind femora armed with 4 large teeth.....................................**Tetrasmicra** Ashmead.
Hind femora armed with 3 large teeth.....................................**Trismicra** Ashmead.

Tribe III. *Chalcitellini.*

This tribe is proposed for a small group closely allied to the tribe *Haltichellini*, but is easily distinguished by the distinctly petiolate abdomen.

The group is unknown to the American fauna, although some South American genera in the *Smicrini* come quite close to it; they are, however, easily separated by having the antennæ inserted farther up on the face and not low down close to the mouth, as in this tribe.

TABLE OF GENERA.

1. Females.. 2
Males.. 4
2. Antennæ 13-jointed.. 3
Antennæ 11-jointed (the club indistinctly jointed).
Hind femora with 7 or 8 large teeth.........**Chalcitella** Westwood (type *C. evanioides* Westw.).
3. Hind tibiæ *without* a tooth outwardly near base, the hind femora armed with many very minute teeth.
Arretocera Kirby (type *Epitranus albipennis* Walk.).
Hind tibiæ *with* a tooth outwardly near base, the hind femora with one large tooth and then finely serrate beyond.............................**Anacryptua** Kirby (type *Epitranus impulsator* Walk.).
4. Characters as in females.

Tribe IV. *Haltichellini.*

This tribe resembles most closely the tribe *Chalcidini* and is separated from it with dicuffilty, the difference in the insertion of the antennæ alone being the only character that readily distinguishes the two tribes.

In this tribe the antennæ are inserted *close* to the mouth border, the scape being long, while the postmarginal vein is wanting, or rarely very long as in the *Chalcidini* and the *Smicrini.*

TABLE OF GENERA.

1. Females.. 2
Males.. 17

2. Hind femora with one or more large teeth or projections beneath, as well as being finely denticulate or serrate 3
Hind femora simple or at most very finely denticulate beneath, without a large tooth or projection 7
3. Metathorax normal, *without* projections 4
Metathorax *with* projections, *i. e.*, spines or teeth on each side posteriorly 14
4. Hind femora with two prominences or elevations beneath and minutely denticulate.
Hockeria Walker (type *H. dexius* Walk.).
Hind femora not so formed, at the most with one prominence or one tooth, the edges beyond usually finely denticulate or serrate 5
5. Antennæ 13-jointed; scape *without* a tooth beneath near the middle .... **Neochalcis** Kirby (type *Euchalcis vetuta* Dufour).
Antennæ 11-jointed; scape *with* a tooth beneath near the middle .... **Euchalcis** Dufour (type *E. miegii* Dufour).
6. Scutellum at apex bidentate; hind femora armed with 11 small teeth beneath; antennæ 11-jointed.
Allocera Sichel (type *A. bicolor* Sichel).
7. Metathorax normal, *without* projections or teeth 8
Metathorax with projections or teeth on each side 14
8. Scutellum normal, neither bidentate nor spined 9
Scutellum either spined or bidentate at apex 11
9. Hind femora beneath with the edges finely denticulate or serrate, the head normal or not very thin antero-posteriorly 10
Hind femora swollen but the edges beneath simple, not denticulate, the head lenticular and very thin antero-posteriorly, wider than the thorax, the ocelli on a straight line; stigmal vein curved, not short, a little longer than half the length of the marginal vein; costal cell broad; antennæ 13-jointed, with 2 ring-joints .... **Encyrtocephalus** Ashmead (type *E. simplicipes* Ashm.).
10. Antennæ 13-jointed; abdomen short, the second segment (first body segment) occupying about half the whole surface; hind femora armed with about 12 small teeth .... **Haltichella** Spinola (type *Chalcis pusilla* Spinola).
Antennæ 12-jointed; abdomen short, the second segment occupying fully half the whole surface; hind femora very minutely denticulate beneath .... **Conura** Spinola (type *C. flavicans* Spinola).
11. Scutellum at apex bidentate 12
Scutellum at apex produced into a long, stout spine 13
12. Antennæ 12-jointed, very long, the scape long; hind femora unarmed .... **Antrocephalus** Kirby (type *Haltichella fascicornis* Walk.).
Antennæ 11-jointed, the flagellum very long and slender; hind femora beneath with the apical half or so finely denticulate and often hairy .... **Stomatoceras** Kirby (type *Halticella liberator* Walk.).
13. Antennæ 11-jointed, the flagellum subclavate, densely pilose; hind femora unarmed.
Aspirhina Kirby (type *Halticella dubitator* Walk.).
Antennæ 12-jointed, the flagellum filiform; hind femora armed with one large triangular tooth, the edges beyond finely serrate .... **Notaspidium** Dalla Torre (type *Notaspis formiciformis* Walk.).
14. Antennæ 10- or 11-jointed 16
Antennæ 12-jointed.
Wings not variegated 15
Wings variegated.
Metathorax with a stout spine on each side; abdomen with the second segment occupying half the whole surface .... **Trichoxenia** Kirby (type *Halticella cineraria* Walk.).

15. Metathorax long with a long projection on each side posteriorly; abdomen not longer than the thorax, subcompressed at the sides, the second segment long; subcostal vein ending in a knob, the marginal, postmarginal and stigmal veins not developed...... **Hybothorax** Ratzeburg (type *H. graffii* Ratzeb.).
Metathorax short, ending in two long divergent spines; abdomen oval, acute at apex, the second segment long; marginal vein present; the stigmal vein short, not distinct.
Kriechbaumerella Dalla Torre (type *Cœlops palpebrator* Kriecht).
16. Antennæ 10-jointed.
Postmarginal vein long and slender, the stigmal vein short, its knob subpetiolate; head viewed from in front triangular; abdomen briefly pointed at apex.
Hippota Walker (type *Chalcis pectinicornis* Latr.).
17. Hind femora *with* one or more large teeth or projections beneath, as well as being finely denticulate or serrate........ 18
Hind femora without a large tooth or projection beneath, simple or smooth, or at the most finely denticulate beneath........ 21
18. Metathorax normal, *without* projections or teeth........ 19
Metathorax *with* projections or teeth on each side........ 28
19. Hind femora with a single large triangular tooth; scutellum produced into an acute spine.
Antennæ 12-jointed........ **Notaspidium** Dalla Torre.
Hind femora with one or two prominent projections beneath near the middle and finely denticulate or serrate.
Hind femora with one prominence........ 20
Hind femora with two prominences........ **Hockeria** Walk.
20. Antennæ 13-jointed........ **Neochalcis** Kirby.
Antennæ 12-jointed........ **Euchalcis** Dufour.
21. Metathorax normal, *without* projections........ 22
Metathorax *with* a projection on each side........ 28
22. Scutellum normal, neither bidentate nor spined........ 23
Scutellum either spined or bidentate........ 25
23. Hind femora beneath with the edges finely denticulate or serrate; head normal, or at least not very thin antero-posteriorly........ 24
Hind femora beneath smooth, not denticulate.
Head lenticular, very thin antero-posteriorly and wider than the thorax; antennæ normal, 13-jointed, with 2 ring-joints; middle tibiæ slender........ **Encyrtocephalus** Ashmead.
Head normal; antennæ *abnormal*, 13-jointed, with 1 ring-joint, the pedicel and first two joints of the flagellum each covered above by a broad lamina or horny flap; middle tibiæ clavate.
Schwarzella Ashmead, g. nov. (type *S. arizonensis* Ashm.).
24. Antennæ 13-jointed........ **Haltichella** Spinola.
Antennæ 12-jointed........ **Conura** Spinola.
25. Antennæ 11- or 12-jointed........ 26
Antennæ 13-jointed.
26. Scutellum produced into a long, stout spine........ 27
Scutellum at apex bidentate or with a median impression.
Antennæ 12-jointed........ **Antrocephalus** Kirby.
Antennæ 11-jointed........ **Stomatoceras** Kirby.
27. Antennæ 11-jointed; hind femora unarmed........ **Aspirhina** Kirby.
Antennæ 12-jointed; hind femora with a large, triangular tooth........ **Notaspidium** Dalla Torre.

28. Antennæ 10- or 11-jointed........ 30
Antennæ 12-jointed.
Wings not variegated........ 29
Wings variegated........ **Trichoxenia** Kirby.
29. Metathorax long, with a long projection on each side posteriorly; subcostal vein ending in a knob, the marginal and stigmal veins not developed........ **Hybothorax** Ratzeburg.
Metathorax short, ending in two long divergent spines; marginal and stigmal veins present.
Kriechbaumerella Dalla Torre.
30. Antennæ 10-jointed (or 11-jointed with a ring-joint)........ **Hippota** Walker.

TRIBE V. *Dirhinini.*

This tribe is distinguished from all the others by having the head deeply emarginate and horned. The antennæ are inserted close to the mouth as in the *Haltichellini.*

TABLE OF GENERA.

1. Female........ 2
Males........ 4
2. Ovipositor not exserted; head with *two* horns........ 3
Ovipositor strongly exserted, long; head with *four* horns; antennæ 13-jointed.
Hontalia Cameron (type *H. cærulea* Cameron).
3. Metathorax strongly bidentate.
Antennæ 12-jointed........ **Dirhinus** Dalman (type *D. excavatus* Dalman).
Antennæ 13-jointed........ **Eniaca** Kirby (type *Chrysis hesperidum* Rossi).
4. Head with *two* horns........ 5
Head with *four* horns.
Metathorax without teeth; antennæ 13-jointed........ **Hontalia** Cameron.
5. Metathorax strongly bidentate.
Antennæ 12-jointed........ **Dirhinus** Dalman.
Antennæ 13-jointed........ **Eniaca** Kirby.

FAMILY LXIII. EURYTOMIDÆ.

1830. Cynipsida Leach, Edinb. Encyc., IX., p. 144.
1833. Eurytomidæ, Family I., Walker, Ent. Mag., I., p. 12.
1840. Eurytomides, Subfamily 2, Westwood, Intro. Mod. Class. Ins., II., p. 166; Synop., p. 66.
1846. Eurytomidæ, Family 3, Walker, List Chalc. Brit. Museum, i., p. 8.
1856. Eurytomoidæ, Familie XII., Förster, Hym. Stud., ii., pp. 19, 23, 44.
1875. Eurytomina, Tribus, Thomson, Hym. Skand., IV., pp. 11, 25.
1886. Eurytominæ, Subfamily, Howard, Ent. Amer., I., p. 19.
1897. Eurytomidæ, Family LXIII, Ashmead, Proc. Ent. Soc. Wash., IV, p. 245.

On account of the diversity of habits among the various groups composing this family it is one of the most interesting of all of the families in this great complex to study, except possibly the family *Agaonidæ.*

Some are phytophagous or gall-makers; others live in the nests of bees and wasps; others are parasitic upon gall-making Hymenoptera and Diptera; while still others are genuine parasites on Coleoptera and other insects, and a few, representing my tribe *Rileyini*, destroy the eggs of orthopterous insects.

The family may be separated into five tribes as follows:

TABLE OF TRIBES.

1. Metathorax seen from above short, *not* longer than the scutellum, usually distinctly *shorter*, and somewhat abruptly declivous 4
   Metathorax seen from above long, always longer than the scutellum and usually gradually sloping to apex (in a single case quadrate and squarely truncate behind) 2
2. Head *not* cornuted; eyes oval or ovate, not round 3
   Head cornuted, much wider than the thorax; eyes round .... Tribe I. Aximini.
3. Marginal vein slender, longer than the stigmal or rarely shorter, but never very stout or stigmated; abdomen most frequently long in both sexes, in female conic-ovate or conically pointed; antennæ dissimilar in the sexes, in females usually subclavate, in males with the joints of the funicle constricted or excised at apex with whorls of long hairs .... Tribe II. Isosomini.
4. Marginal vein short and stout, stigmated, either quadrate or semicircular 6
   Marginal vein usually slender, linear, rarely stout, but never stigmated, quadrate, or semicircular 5
5. Antennæ 10- to 12-jointed, with only *one* ring-joint, and dissimilar in the sexes, in females filiform or subclavate, in males with the funicle joints excised or petiolate at apex, with whorls of long hairs or with sparse long hairs .... Tribe III. Eurytomini.
   Antennæ 13-jointed, with *two* or *three* ring-joints, and very similar in the sexes, the funicle joints not excised or pedicellate at apex, and without whorls of long hairs .... Tribe IV. Rileyini.
6. Antennæ at the most 11-jointed, with 1 ring-joint, the funicle 4-jointed and very similar in both sexes, filiform or subclavate, without whorls of long hairs; abdomen short, globose, or oval, never very long or strongly compressed; hind tibiæ with rigid bristles behind .... Tribe V. Decatomini.

Tribe I. *Aximini.*

Mr. Peter Cameron, in Biol. Centr. Amer. Hym., Vol. 1, p. 111, established for *Axima* Walker and *Hontalia* Cameron, the subfamily *Aximinæ*. The two genera, however, have nothing in common, are quite distinct in structural characters and belong to different families. Mr. Cameron was evidently deceived in regard to their relationship by a superficial resemblance in the structure of the heads of these insects. *Axima* is clearly a eurytomid, as I first pointed out several years ago, while *Hontalia* is a chalcidid allied to *Dirhinus*, and must be placed in my tribe *Dirhinini*. *Axima* is parasitic in the nests of the small carpenter bees, *Ceratinidæ*.

TABLE OF GENERA.

1. Females 2
   Males 3
2. Marginal vein four or more times longer than the stigmal vein; antennæ 11-jointed, the funicle 6-jointed; abdomen long, lanceolate, compressed .... **Axima** Walker (type *A. spinifrons* Walk.).

Marginal vein hardly twice the length of the stigmal vein; antennæ 11-jointed; abdomen not long, lanceolate.............................**Aximopsis** Ashmead, gen. nov. (type *A. morio* Ashm.).

3. Marginal vein four or more times longer than the stigmal; antennæ 11-jointed, the funicle joints long, binodose, each joint with two whorls of long hairs..............................**Axima** Walker.

Marginal vein hardly twice the length of the stigmal vein.................... **Aximopsis** Ashmead.

Tribe II. *Isosomini.*

All the species falling in this tribe are phytophagous and thus differ in habits from all of the other tribes.

The group approaches very close to the *Eurytomini* and many of the species were at first described under the genus *Eurytoma.* There is, however, a well marked structural difference between them, and the tribe may be easily separated by the characters made use of in my table of tribes. In having a long metathorax and in the antennal characters of most of the genera, the *Isosomini* approach nearest to the *Aximini,* but the horned head in the latter is sufficient to keep them apart.

TABLE OF GENERA.

1. Females 2

Males.. 8

2. Apterous... 7

Winged.

Marginal vein always longer than the stigmal vein... 3

Marginal vein shorter than the stigmal vein, the latter very oblique, extending off from the marginal at an angle of thirty degrees.

Head and thorax umbilicately punctate, the frons with a deep antennal furrow; abdomen elongate, conic-ovate, the dorsal segments subequal, as in *Isosoma.*

Isosomodes Ashmead (type *Isosoma gigantea* Ashm.).

3. Metathorax sloping or rounded behind, not abruptly and squarely truncate behind................ 4

Metathorax quadrate, abruptly and squarely truncate behind.

Mesonotum delicately umbilicately punctate; abdomen ovate, slenderer than the thorax, the second segment the longest, the others about of an equal length.

Isosomorpha Ashmead (type *I. europæ* Ashm.).

4. Thorax more or less distinctly umbilicately punctate, punctate or shagreened, opaque, never smooth and shining; antennæ usually 11-jointed, with 1 ring-joint, the funicle 5-jointed................ 5

Thorax smooth and shining, impunctate or at the most feebly microscopically shagreened.......... 6

5. Mesonotum umbilicately punctate, punctate or rugulose; abdomen usually long, conically pointed, the segments subequal in length, the fourth not or only slightly longer than the third.

Isosoma Walker (type *Ichneumon verticellata* Fabr.).

Mesonotum with the middle lobe nearly smooth, delicately punctate, with usually delicate transverse aciculations anteriorly; abdomen very long, conically pointed, the fourth segment very long.

Euoxysoma Ashmead (type *Systole brachyptera* Ashm.).

6. Pedicel longer than the first joint of the funicle, the joints of the latter moniliform or nearly; abdomen ovate, with the fourth segment much longer than the others, except the second; postmarginal vein scarcely longer than the stigmal vein.............**Isosomocharis** Ashmead (type *I. sulcat* Ashm.).

Pedicel shorter than the first joint of the funicle or no longer, the first three joints of the funicle obconical; abdomen conically pointed, with the segments, except the second, which is the longest, nearly of an equal length (sexual form) .... **Philachyra** Haliday (type *P. ips* Hal.).

7. Mesonotum and scutellum highly polished, impunctate; abdomen conic-ovate, as long as the head and thorax united; antennæ 11-jointed, the funicle 5-jointed, the first joint the longest, obconical, longer than the pedicel (Agamic form).. **Philachyra** Haliday.

8. Marginal vein always longer than the stigmal vein 9

Marginal vein shorter than the stigmal vein.

Head and thorax umbilicately punctate, the former with a deep frontal furrow; flagellum filiform, the joints of the funicle long, three or more times longer than thick, briefly pedicellate at apex, with two whorls of long hairs on each joint .... **Isosomodes** Ashmead.

9. Metathorax not abruptly and squarely truncate behind, either sloping or rounded 10

Metathorax quadrate, abruptly and squarely truncate behind; head and thorax umbilicately punctate. **Isosomorpha** Ashmead.

10. Thorax smooth and shining, impunctate or at the most very feebly, microscopically shagreened... 13

Thorax more or less distinctly umbilicately punctate, finely punctate, or coarsely shagreened, opaque.. 11

11. Head and thorax finely punctate.. 12

Head and thorax more or less umbilicately punctate or coarsely shagreened.

Mesonotum more or less distinctly umbilicately punctate, not finely transversely aciculate anteriorly; funicle joints long, more than thrice longer than thick, constricted or briefly pedicellate at apex, with indistinct whorls of long hairs ....**Isosoma** Walker.

Mesonotum not so punctate, the middle lobe smoother, delicately punctate, with usually delicate transverse aciculations anteriorly.......................................**Euoxysoma** Ashmead.

12. Metathorax elongate; abdomen clavate, the petiole slender, punctate, as long as the hind coxæ, the body a little longer than the thorax; antennæ filiform, slender, pubescent. **Aiolomorphus** Walker (type *A. rhopaloides* Walk.).

13. Funicle joints long, subcontracted near the middle and subpetiolate at apex, each joint with two, somewhat irregular, whorls of long hairs....................................**Isosomocharis** Ashmead.

Funicle joints long, petiolate or subpetiolate at apex, with long hairs, but not arranged in two whorls and the joints cylindrical, without a median contraction; abdomen oblong-oval, the petiole rugulose, about twice as long as thick or a little longer, the second segment the longest segment, longer than the third and fourth united, the latter about equal with those beyond........**Philachyra** Haliday.

Tribe III. *Eurytomini.*

This is the most extensive tribe in the family and the National Museum collection contains many undescribed species. All of the species are genuine parasites and destroy the larvæ of several orders, Hymenoptera, Diptera, Coleoptera, etc.

Dr. A. D. Hopkins, of the West Virginia State Agriculture College, claims, however, that *Bruchophagus* (*Eurytoma*) *funebris* Howard is phytophagous and states he has proved it by a series of experiments. I think, however, some mistake has been made and I cannot accept Dr. Hopkins' observation as conclusive. Dr. Howard described it as having been bred from *Cecidomyia lugumicola* Lintner, living

in clover seed. All the other species, however, belonging to this genus, whose parasitism is known, destroy coleopterous larvæ, and I am inclined to think that both Drs. Howard and Hopkins are wrong, and that *Bruchophagus funebris* is a parasite upon some *Bruchus*, or the larva of a small rhynchophorous beetle living in the clover seed.

The genera are numerous, but it is believed these may be easily recognized by the use of the following table:

TABLE OF GENERA.

1. Females 2
   Males 15
2. Non-metallic 3
   Metallic green or blue, coarsely, umbilicately punctate.
      Head in front quadricarinate (a carina along the inner orbits and bounding the frontal furrow); eyes surrounded by a ring of coarse punctures; antennæ 11-jointed, sometimes appearing only 9-jointed by the union of the club joints; funicle 5-jointed, the joints long, the first the longest, about two-thirds the length of the scape; abdomen conic-ovate, the fifth segment the longest .... **Chryseida** Spinola (type *C. superciliosa* Spinola).
3. Mesonotum distinctly umbilicately punctate 4
   Mesonotum not umbilicately punctate, smooth or nearly, shagreened, or at least rugulosely punctate .. 12
4. First joint of the funicle elongate, as long or nearly as the scape, or at least never less than two-thirds the length of the scape 5
   First joint of the funicle not especially long, never longer than half the length of the scape, but usually much shorter than that 6
5. Head with a deep antennal channel, the front ocellus lying in it at apex; antennæ 11-jointed, filiform, not or only slightly thickened toward apex.
      Abdomen rarely much longer than the head and thorax united, strongly compressed, pointed at apex; seen from the side, the dorsum is strongly convexly elevated, the fifth segment the longest .... **Bephrata** Cameron (type *B. ruficollis* Cam.).
      Abdomen very elongate, narrow, lanceolate, compressed, fully twice as long as the head and thorax united, the segments more nearly equal in length.
      Aximogastra Ashmead, gen. nov. (type *A. bahiæ* Ashm.).
6. Mesonotum *with* distinct, complete parapsidal furrows 7
   Mesonotum *without* parapsidal furrows or the furrows are only indicated anteriorly 14
7. Head sometimes with a deep frontal channel or antennal furrow, but the front ocellus is never placed within it, but always above it near the anterior margin of the vertex 8
   Head with a deep frontal channel or antennal furrow, the front ocellus always placed at the apex of this furrow, never above it.
      Scape elongate, more than twice longer than the first joint of the funicle, the funicle joints rather long, the first about twice as long as thick; abdomen compressed, not longer than the head and thorax united, ending in a conical point; the dorsum, as seen from the side, is highly convexly elevated; postmarginal vein variable, sometimes shorter than the marginal, but rarely very much longer; hind tibiæ with rather short, stiff bristles behind.
      Prodecatoma Ashmead, gen. nov. (type *P. flavescens* Ashm.).

8. Marginal vein always distinctly longer than the stigmal vein, the postmarginal vein well developed, sometimes very long 9
Marginal vein short, not, or scarcely, longer than the stigmal vein, usually a little shorter, the post-marginal vein rarely well developed, rarely as long as the stigmal (in only a single case is it very long) .. 13
9. Hind tibiæ with 2 apical spurs 10
Hind tibiæ with 1 apical spur.
Funicle with the joints oval-moniliform; eyes broadly oval.
Phylloxeroxenus Ashmead (type *Eurytoma phyllexeræ* Ashm.).
10. Postmarginal vein very long, fully twice as long (or even longer) as the stigmal vein 11
Postmarginal vein not much longer than the stigmal vein.
Marginal vein scarcely longer than the stigmal; antennæ clavate, the club large, 3-jointed, the joints of the funicle moniliform; abdomen with the fifth segment, as seen from the side, two or more times longer than wide; head convex in front, the occiput deeply concave.
Eurytomocharis Ashmead (type *E. minuta* Ashm.).
Marginal vein very distinctly longer than the stigmal; antennæ filiform or nearly, at most subclavate, not greatly thickened towards apex, the joints of the funicle oblong, cylindrical; abdomen conic-ovate, subcompressed, the fifth segment, as seen from the side, shorter than wide .... **Eurytoma** Illiger (type *E. planata* Illig.).
11. Hind tibiæ normal, not dilated 12
Hind tibiæ compressed, dilated.
Head transverse, wider than the thorax, and thin antero-posteriorly, the eyes more or less rounded, prominent; antennæ inserted far above the middle of the face, the scape very long, reaching far above the ocelli and with a tooth or tubercle at apex beneath, the flagellum filiform with sparse hairs, the funicle joints more than twice longer than thick; abdomen very strongly compressed, the petiole long and slender. **Eudoxinna** Walker (type *Sesxetra transversa* Walk.).
12. Marginal vein at least one and a half times as long as the stigmal vein, the postmarginal vein not longer than the stigmal; abdomen conic-ovate, longer than the thorax, the fifth segment nearly twice as long as the fourth; antennæ 11-jointed, the flagellum subclavate, the joints of the funicle submoniliform .... **Xanthosoma** Ashmead (type *X. nigricornis* Ashm.).
Marginal vein not or scarcely longer than the stigmal vein and stout; antennæ 11-jointed, the flagellum clavate or subclavate; abdomen globose, or short ovate, shorter than the thorax, the segments subequal .... **Systole** Walker (type *S. albipennis* Walk.).
13. Abdomen short, subglobose, the fourth segment much the longest, enclosing the following.
Systolodes Ashmead (type *S. brevicornis* Ashm.).
Abdomen ovate, subcompressed (the tip sometimes produced into a stylus), the fourth and fifth segments short, although a little longer than the others, and subequal .... **Bruchophagus** Ashmead (type *B. borealis* Ashm.).
14. Head with a deep frontal furrow; abdomen ovate, subcompressed, petiolate, the petiole usually not short, the fifth segment the longest, but not greatly longer than the fourth.
Funicle 5-jointed, the joints moniliform or submoniliform, the first much shorter than the pedicel .... **Decatomidea** Ashmead (type *D. xanthochroa* Ashm.).
15. Non-metallic, smooth, delicately shagreened or umbilicate punctate, rarely finely punctate 16
Metallic green or blue, coarsely umbilicately punctate.
Head in front quadricarinate, the carina along the orbits sometimes delicate; funicle with the joints excised at apex above, with whorls of long hairs .... **Chryseida** Spinola.

16. Mesonotum closely, distinctly, umbilicately punctate.......... 17
Mesonotum *not* umbilicately punctate, either smooth or nearly, or shagreened or finely, regularly sculptured.......... 26
17. First joint of the flagellum long, as long as the scape or longer.......... 18
First joint of the flagellum not especially long, always much shorter than the scape.......... 19
18. Head with a deep antennal furrow, the front ocellus placed within the furrow.
? Known to me in ♀ sex only.......... **Bephrata** Cameron.
? Known to me in ♀ sex only.......... **Aximogastra** Ashmead.
19. Mesonotum *without* or with incomplete furrows.......... 28
Mesonotum *with* distinct, complete furrows.
Head sometimes with a deep antennal furrow, but the front ocellus is never situated in the furrow.......... 20
Head with a deep antennal furrow, the front ocellus always placed in the furrow at its apex. **Prodecatoma** Ashmead.
20. Marginal vein always distinctly longer than the stigmal vein, the postmarginal vein well developed, sometimes very long, always longer than the stigmal.......... 21
Marginal vein short, not or scarcely longer than the stigmal vein, usually shorter, the postmarginal vein not well developed, not longer than the stigmal.......... 27
21. Hind tibiæ with 2 apical spurs.......... 22
Hind tibiæ with 1 apical spur.......... **Phylloxeroxenus** Ashmead.
22. Postmarginal vein only a little longer than the stigmal vein.......... 23
Postmarginal vein very long, fully twice as long (or longer) as the stigmal vein.......... 25
23. Marginal vein always distinctly longer than the stigmal vein.......... 24
Marginal vein only a little longer than the stigmal.......... **Eurytomocharis** Ashmead.
24. Funicle 5-jointed, the joints at apex excised above and pedicellate with long, whorled hairs; body of abdomen rather small, subovate, the petiole usually longer than the hind coxæ, the fourth segment, counting the petiole as the first, the longest.......... **Eurytoma** Illiger.
25. Scape of antennæ long, with a tooth or tubercle at apex beneath; joints of funicle long, slightly contracted at the middle, each joint with two whorls of long bristles.......... **Eudoxinna** Walk.
26. Marginal vein slender, at least one and a half times as long as the stigmal vein, the postmarginal vein not longer than the stigmal.......... **Xanthosoma** Ashm.
Marginal vein rather stout, not longer than the stigmal vein; funicle 4-jointed, the joints oval, briefly petiolate at apex, with long, sparse hairs; abdomen small, oval, the petiole about twice as long as thick; dorsal segment 2–4 subequal.......... **Systole** Walk.
27. Funicle 4-jointed, the joints excised at apex above, the basal or thickened portion about twice as long as thick, with long hairs above; abdomen small, globose, the petiole rugulose, the fourth segment the longest.......... **Systolodes** Ashmead.
Funicle 4-jointed, the joints briefly pedunculate at apex, with sparse, long, irregular hairs; body of abdomen oval, the petiole short, stout, the fourth segment the largest.......... **Bruchophagus** Ashmead.
28. Head with a deep antennal furrow.......... **Decatomidea** Ashmead.

Tribe IV. *Rileyini.*

In this tribe the antennæ are alike, or very similar, in both sexes and 13-jointed, with *two* or *three* ring-joints; they are never 12-jointed or less as in the other tribes.

I consider the species composing this tribe to be genuine Eurytomids, but with a *habitus* quite their own and difficult to describe intelligently — the head, pronotum and abdomen being slightly different from those in the *Eurytomini.* The sculpture, too, except in the genus *Neorileya,* is different from other Eurytomids. The shape of the abdomen in some of the species recalls to mind the subfamily *Ormyrinæ,* in the Torymidæ, the species of which have similar antennæ and show same affinity with this tribe.

Macrorileya is parasitic in the eggs of tree-crickets (*Œcanthus* sp.); a species of *Neorileya* was bred by Mr. Urich, in Trinidad, W. I., from an egg of an unknown orthopterous insect; while the species belonging to the genus *Rileya* are parasitic upon the larvæ of various Cecidomyiids.

TABLE OF GENERA.

1. Females.. 2
   Males.. 4
2. Head and thorax smooth or nearly or at the most, very finely punctate, or feebly microscopically shagreened.. 3
   Head and thorax umbilicately punctate.
      Pronotum as wide as the mesonotum, the hind margin arcuately emarginate, straight and truncate in front; mesonotum *without* furrows; axillæ rather small, triangular, widely separated; antennæ 13-jointed, with *two* ring-joints, the flagellum short, not twice the length of the scape, subfiliform, the funicle 6-jointed, the joints subquadrate, hardly as long as wide; marginal vein scarcely longer than the stigmal, shorter than the postmarginal; abdomen oval, depressed, shorter or not longer than the thorax, subconvex above, and briefly petiolate, the fourth segment much the longest, the third very short, the second and fifth about equal, united not longer than the fourth......**Neorileya** Ashmead, g. nov. (type *N. flavipes* Ashm.).
3. Antennæ with *three* ring-joints.
      Pronotum as wide as the mesonotum, the hind margin straight, a little more than twice wider than long and about as long as the mesonotum; parapsidal furrows delicate but complete, or nearly, sometimes obliterated anteriorly; head transverse, a little wider than the thorax; flagellum subclavate, the funicle 5-jointed, joints 3–5 transverse; marginal vein fully twice as long as the stigmal and a little longer than the postmarginal; abdomen subcylindrical, conic-ovate, a little longer than the head and thorax united, almost sessile, the fourth segment very large, occupying most of the surface, the others very short...............**Rileya** Ashmead (type *R. cecidomyiæ* Ashm.).
      Pronotum quadrate, a little narrower than the mesonotum and hardly shorter than wide; parapsidal furrows distinct, complete; head transverse, as wide as the thorax across from tegula to tegula, subconcave behind, convex in front, with a frontal excavation for the antennal scape; flagellum subclavate, the funicle 6-jointed, joints 2–6 subquadrate, the last two a little wider than long; marginal vein very long, more than twice longer than the stigmal vein, the postmarginal vein very long and slender; abdomen very long and narrow, lanceolate, subcompressed, nearly twice as long as the head and thorax united, joints 5, 6 and 7 long, the sixth the longest of the three, the eighth projecting and pointed.
      Macrorileya Ashmead g. nov. (type *Rileya œcanthi* Ashm.).

4. Antennæ with *three* ring-joints 5
Antennæ with *two* ring-joints.
Head and thorax umbilicately punctate, the parapsidal furrows wanting; pronotum as wide as the mesonotum, the hind margin arcuately emarginate; flagellum filiform, pubescent, the joints subquadrate .... **Neorileya** Ashmead.
5. Head and thorax smooth or nearly, at most very finely punctate or microscopically shagreened, the parapsidal furrows sometimes delicate but distinct.
Pronotum as wide as the mesonotum, more than twice wider than long; abdomen ovate, the fourth segment very long; flagellum filiform, pubescent, the joints of the funicle nearly equal, a little wider than long.. **Rileya** Ashmead.
Pronotum quadrate, nearly as long as wide and a little narrower than the mesonotum; abdomen elongate, cylindrical, as long as the head and thorax united, the segments subequal; flagellum subclavate, gradually thickened towards the tip, the last two joints of funicle transverse.
Macrorileya Ashmead.

Tribe V. *Decatomini.*

This tribe is very closely allied to the tribe *Eurytomini,* but is readily separated from it and the other tribes by the much thickened or stigmated marginal vein, and by the antennæ being alike, or very similar, in both sexes. The hind tibiæ are always armed with rigid bristles behind. Some of the *Eurytomini,* however, also have similarly armed tibiæ, so that this character in itself is not sufficient to distinguish the group.

All the species are parasitic upon hymenopterous and dipterous gall-makers. (*Cynipidæ* and *Cecidomyiidæ*).

Only two genera fall into this tribe, distinguished as follows:

TABLE OF GENERA.

1. Females 2
Males 3
2. Wings hyaline, with a dusky submarginal blotch or band; antennæ 9-jointed, with one ring-joint, the club usually not jointed, if with 3 indistinct joints, 11-jointed, pedicel obconical, nearly thrice as long as thick at apex. .... **Decatoma** Spinola (type *Diplolepis adonidum* Rossi).
Wings hyaline, without a dusky submarginal blotch; pedicel shorter, not or hardly twice as long as thick at apex .... **Eudecatoma** Ashmead (type *E. batatoides* Ashmead).
3. Wings hyaline, *with* a dusky or fuscous submarginal blotch or band .... **Decatoma** Spinola.
Wings hyaline, *without* a dusky submarginal blotch; all femora considerably swollen.
Eudecatoma Ashmead.

Family LXIV. PERILAMPIDÆ.

1846. Eucharidæ, Family (partim), Walker, List Chalc. Brit. Museum, I., p. 103.
1856. Perilampoidæ, Family IX., Förster, Hym. Stud., II., pp. 19, 22 and 46.
1875. Perilampina, Tribus, Thomson, Hym. Skand., IV., pp. 11, 22.
1886. Perilampinæ, Subfamily, Howard, Ent. Amer., I., p. 198.

1897. Perilampidæ, Family LXIV., Ashmead, Proc. Ent. Soc. Washington, IV., p. 245.

Francis Walker placed this family with the *Eucharidæ*, with which it is unquestionably closely allied. It is, however, easily separated from the *Eucharidæ* by many salient differences, and I agree with Dr. Förster in considering it a distinct family. It has some affinities allying it with the family *Miscogasteridæ*, the affinities existing also in the *Eucharidæ* and particularly through Cameron's genus *Orasema*.

Chrysolampus Spinola belongs to this family and not with the *Pteromalidæ*, where Dr. Von Dalla Torre has placed it. His changing the well-known subfamily *Sphigigasterinæ* into *Chrysolampinæ*, is therefore unnecessary and unwarranted. *Chrysolampus* is identical with *Lamprostylus* Förster.

The group attacks principally Lepidoptera, but will also attack other insects, as I have bred *Perilampus* sp. from Chrysopa cocoons.

The genera are not numerous and are characterized in the following table:

TABLE OF GENERA.

1. Abdomen petiolate 6
   Abdomen sessile or subsessile 2
2. Scutellum normal, although sometimes very large, not produced into a long spine 3
   Scutellum produced into a long spine .... **Euperilampus** Walker (type *Perilampus gloriosus* Walk.).
3. Thorax smooth, not coarsely punctate 5
   Thorax coarsely punctate.
      Antennæ 13-jointed 4
      Antennæ 9-jointed (teste Kriechbaumer) .... **Sericops** Kriechbaumer (type *S. fasciata* Kriechbaumer).
4. Flagellum very short, compacted into a short club .... **Philomides** Haliday (type *P. paphius* Haliday).
   Flagellum not very short, at the most subclavate ... **Perilampus** Latreille (type *Cynips italica* Fabricius).
5. Antennæ inserted below the middle of the face, 13-jointed; stigmal and postmarginal veins abbreviated. **Chrysomalla** Förster (type *C. roseri* Förster).
6. Antennæ simple 7
   Antennæ pectinate. ♂ (♀ unknown) .... **Aperilampus** Walker (type *Perilampus discolor* Walker).
7. Metathorax thickly and deeply punctate .... **Chrysolampus** Spinola = *Lamprostylus* Förster (type *C. splendidula* Spinola).
   Metathorax not so punctured, smooth or with only a few punctures .... **Elatus** Walker (type *E. thenæ* Walker).

Family LXV. EUCHARIDÆ.

1846. Eucharidæ, Family 5 (partim), Walker, List. Chalc. British Museum, I., p. 21.
1856. Eucharoidæ, Familie 8, Förster, Hym. Stud., II., pp. 18, 22 and 42.
1886. Eucharinæ, Subfamily, Howard, Ent. Amer., I., p. 198.
1897. Eucharidæ, Family LXV., Ashmead, Proc. Ent. Soc. Washington, IV., p. 235.
1899. Eucharidæ, Family LXV., Ashmead, *loc. cit.*, p. 245.

1900. Eucharidæ, Family LXV., Ashmead, Proc. U. S. National Museum, XXIII., p. 202.

In this family are found some of the most singular looking and wonderfully shaped Chalcids known, the structure of the thorax, and particularly of the scutellum, being most wonderfully and curiously modified and developed; and this development, in connection with the brilliant metallic green and blue colors of its members, makes the group the most striking and attractive of any in the Superfamily. Some of the species are now known to be parasitic upon ants and probably the whole group attacks these insects. In temperate regions the family is poorly represented, but in tropical countries, where ants most abound and flourish in enormous colonies, these insects are not rare and seem to have reached a very highly specialized development.

The known genera may be tabulated as follows:

TABLE OF GENERA.

1. Females.......... 2
   Males.......... 21
2. Antennæ 13-jointed or less.......... 3
   Antennæ 14-pointed or more.
      Scutellum simple; antennæ 16–18-jointed.....**Eucharissa** Westwood (type *E. speciosa* Westw.).
      Scutellum produced posteriorly into a spine which is longitudinally striate; antennæ 14-jointed. **Saccharissa** Kirby (type *Eucharis contingens* Walker).
3. Scutellum simple, neither bidentate nor produced into long processes.......... 4
   Scutellum bidentate or produced posteriorly into long processes over the abdomen.......... 11
4. Antennæ moniliform.......... 5
   Antennæ not moniliform.......... 6
5. Abdomen compressed, ascending..........**Eucharis** Latreille (type *Cynips adscendens* Fabr.).
   Abdomen neither compressed nor ascending.
      Hind tarsi with the first joint much thickened; antennæ 11-jointed..........**Tricoryna** Kirby (type *Eucharis jello* Walt.).
      Hind tarsi with the first joint very long, but not thickened..........**Metagea** Kirby (type *Eucharis Zalates* Walk.).
6. Joints of antennæ not serrate, cylindrical.......... 7
   Joints of antennæ serrate or subdentate.......... 9
7. Antennæ 13-jointed, the joints short.......... 8
   Antennæ 11-jointed, the joints long.
      Thorax smooth, polished; petiole of abdomen abruptly enlarged at apex. **Pseudometagea** Ashmead (type *Metagea schwarzii* Ashm.).
      Thorax rugose; petiole of abdomen normal, long and cylindrical........**Psilogaster** Blanchard (type *P. cupreus* Blanchard).
8. Thorax not greatly elevated, similar to *Chrysolampus* in the Perilampidæ, punctate and with complete parapsidal furrows; mandibles long, acute at apex, the right mandible with *two* teeth within, the left with *one* tooth within..........**Orasema** Cameron (type *O. stramineipes* Cam.).

9. Antennæ 11-jointed 10
Antennæ 13-jointed .... **Rhipipallus** Kirby (type *Eucharis volusus* Walk.).
10. Scutellum rounded, not conically elevated posteriorly; wings hyaline. **Pseudochalcura** Ashmead g. nov. (type *Eucharis gibbosa* Provancher).
Scutellum subconically elevated posteriorly; wings with a substigmal cloud or fascia. **Chalcura** Kirby (type *Eucharis deprivata* Walk.).
11. Scutellum with the processes very long, usually as long as the abdomen and sometimes very broad, forming a shield over the abdomen, or conically produced 13
Scutellum bidentate, the processes never very long.
Metathorax armed with strong lateral projections or teeth 12
Metathorax unarmed, without teeth.
A hump-like elevation above the metapleura .... **Stilbula** Spinola (type *Ichneumon cynipiformis* Rossi).
No hump-like elevation above the metapleura .... **Schizaspidia** Westwood (type *S. furcifera* Westw.).
12. Metathoracic processes curving downwards .... **Lophyrocera** Cameron (type *L. stramineipes* Cam.).
Metathoracic processes consisting of two diverging horizontal teeth .... **Tetramelia** Kirby (type *Schizaspidia plagiata* Walk.).
13. Scutellum not conically produced 14
Scutellum conically produced over the abdomen.
Head with a deep antennal furrow; hind femora very broad; abdomen subsessile, fusiform, depressed .... **Destefania** Dalla Torre (type *Sternodes Pasateri* De Stef.).
14. Scutellar processes long and slender, generally curving inward toward tips 18
Scutellar processes very broad and covering the entire abdomen.
Thorax not pubescent, the apex of the scutellar processes simple, or cleft or notched 15
Thorax pubescent, the apex of the scutellar processes rounded and not sharply cleft, the notch extending two thirds the entire length 17
15. Scutellar processes long, broad and contiguous, but very flat, the extremities rounded, subtruncate, or furnished with two rounded short spines 16
Scutellar processes not so shaped.
Scutellar processes very broad, triangular .... **Thoracantha** Latreille (type *T. latreillei* Guérin).
Scutellar processes long, contiguous and acutely pointed at tips, longitudinally striate. **Uromelia** Kirby (type *Thoracantha striata* Perty).
16. Mesonotum and scutellum medially impressed; head almost as wide as the thorax; antennæ 10-jointed, the third joint as long as the scape, the following much wider than long .... **Dicœlothorax** Ashmead (type *D. platycerus* Ashm.).
Mesonotum and scutellum not so impressed, the scutellar processes having the basal portion as wide as the thorax, briefly compressed in the center, then dilated and at the apex furnished with two rounded short spines .... **Lætocantha** Shipp (type *Thoracantha nasua* Walk.).
17. Antennæ 10-jointed, the first funicle joint the longest, the following short .... **Dilocantha** Shipp (type *Thoracantha flavicornis* Walk.).
18. Head and eyes normal, not tuberculate 19
Head and eyes tuberculate.
Antennæ 12-jointed .... **Isomeralia** Shipp (type *Thoracantha coronata* Westw.).
19. Antennæ 11-jointed, the third joint not much longer than the fourth 20

Antennæ 10-jointed, the third joint very long, as long as all of the other joints united.
Lirata Cameron (type *L. luteogaster* Cam.).

20. Thorax not pubescent, the scutellum always longitudinally striate .... **Kapala** Cameron (type *Eucharis fuscata* Fabr.).
Thorax clothed with a fine pubescence, the scutellum smooth, not longitudinally striate, the processes smooth to their apices, where they are transversely serrate .... **Lasiokapala** Ashmead (type *L. serrata* Ashm.).

21. Scutellum spined, bidentate or produced into long processes extending over the scutellum 22
Scutellum normal, simple 23

22. Scutellum bidendate or produced into long processes that extend over the abdomen 28
Scutellum produced into a spine-like process.
Antennæ never more than 13-jointed 29
Antennæ 18-jointed .... **Saccharissa** Kirby.

23. Antennæ 10–13-jointed 24
Antennæ 22-jointed .... **Eucharissa** Westwood.

24. Antennæ simple, without branches 25
Antennæ ramose or with branches 28

25. Flagellar joints moniliform 26
Flagellar joints cylindrical, not moniliform 27

26. Abdomen compressed, ascending .... **Eucharis** Latreille.
Abdomen neither compressed nor ascending.
First joint of tarsi much thickened .... **Tricoryna** Kirby.
First joint of tarsi very long, slender .... **Metagea** Kirby.

27. Antennæ 10–11-jointed.
Petiole of abdomen abruptly enlarged at apex; thorax smooth ...... **Pseudometagea** Ashmead.
Petiole of abdomen normal, long, cylindrical; thorax rugose .... **Psilogaster** Blanchard.
Antennæ 13-jointed, rather short; thorax closely punctate, the parapsidal furrows distinct; right mandible with two teeth within, the left with one tooth within .... **Orasema** Cameron.

28. Scutellum spined, bidentate or produced into long processes that extend over the abdomen 29
Scutellum normal, unarmed.
Antennæ with 4 branches; wings hyaline .... **Pseudochalcura** Ashmead.
Antennæ with more than four branches; wings with a substigmal cloud or fascia.
Chalcura Kirby.

29. Scutellum not conically produced into a spine 30
Scutellum conically produced into a spine .... **Destefania** Dalla Torre.

30. Scutellum with the processes very long, usually as long as the abdomen and sometimes very broad, forming a shield over the abdomen 32
Scutellum bidentate, the teeth never very long.
Metathorax armed with strong lateral projections or teeth 32
Metathorax unarmed, without teeth.
A hump-like elevation above the metapleura .... **Stibula** Spinola.
No hump-like elevation above the metapleura .... **Schizaspidia** Westwood.

31. Metathoracic processes curving downwards; antennæ simple .... **Lophyrocera** Cameron.
Metathoracic processes consisting of two horizontal teeth; antennæ with 9 branches.
Tetramelia Kirby.

32. Scutellar processes long and slender, generally curving inward toward tips 36
Scutellar processes broad, contiguous their entire length or at least basally 33
33. Scutellar process long, broad and contiguous, but very flat, the extremities rounded, subtruncate or furnished with two rounded, short spines 34
Scutellar processes not so shaped.
Scutellar process very broad, deeply, semicircularly emarginate at apex; antennæ with 9 branches .... **Thoracantha** Latreille.
Scutellar processes long, triangularly pointed and longitudinally striate; antennæ with 8 branches .... **Uromelia** Kirby.
34. Thorax pubescent 35
Thorax *not* pubescent.
Mesonotum and scutellum medially impressed; antennæ 10-jointed.... **Dicœlothorax** Ashmead.
Mesonotum and scutellum not impressed, the scutellar processes at base as wide as the thorax, briefly compressed in the center, then dilated and at apex furnished with two rounded, short spines .... **Lætocantha** Shipp.
35. Scutellar processes at apex rounded and not sharply cleft, the notch extending two thirds the entire length .... **Dilocantha** Shipp.
36. Head and eyes normal, not tuberculate 37
Head and eyes tuberculate .... **Isomeralia** Shipp.
37. Antennæ 11-jointed, the third joint not much longer than the fourth 38
Antennæ 10-jointed, the third joint very long, as long as the other joints united ... **Lirata** Cameron.
38. Thorax not pubescent, the scutellum longitudinally striate .... **Kapala** Cameron.
Thorax clothed with a fine pubescence, the scutellum smooth, not striate, the apices of the scutellar processes serrate .... **Lasiokapala** Ashmead.

Family LXVI. MISCOGASTERIDÆ.

1833. Miscogasteridæ, Family 4 (partim), Walker, Ent. Mag., I, p. 370.

1856. Miscogasteroidæ, Familie 14 (partim), Förster, Hym. Stud., II, pp. 19, 24 and 51.

1875. Pteromalina, Tribus (partim), Thomson, Hym. Skand., IV., pp. 12 and 216.

1886. Pteromalinæ, subfamily (partim), Howard, Ent. Amer., I, p. 198.

1897. Miscogasteridæ, Family LXVI., Ashmead, Proc. Ent. Soc. Washington, IV., pp. 235 and 245.

1900. Miscogasteridæ, Family LXVI., Ashmead, Proc. U. S. National Museum, XXIII., p. 202.

This family very closely resembles the family *Pteromalidæ*, and the two are separated with difficulty, the only reliable character to separate them being the number of apical spurs on the hind tibiæ. In this family the hind tibiæ have *two* apical spurs, while in the *Pteromalidæ* there is but *one* apical spur. It is a good character but not easily seen in the smaller species, and the greatest care and caution must be exercised in examining specimens before they can be placed in their proper families. A very strong lens is required to see the spurs and sometimes it will be found

necessary to use the compound microscope before the number of spurs, in these minute chalcidids, can be definitely settled.

Four distinct subfamilies, distinguished by the characters made use of in the following table, have been recognized :

TABLE OF SUBFAMILIES.

1. Metathorax at apex produced beyond the insertion of the hind coxæ; the abdomen petiolate or subpetiolate 4
   Metathorax normal, not produced at apex 2
2. Abdomen distinctly petiolate; if subsessile it is elongate and strongly carinate beneath 3
   Abdomen sessile or subsessile.
   Antennæ 8–11-jointed, inserted just above the clypeus or close to the mouth border. Subfamily I. PIRENINÆ.
   Antennæ 12–13-jointed, and most frequently inserted far above the clypeus, very rarely inserted just above the clypeus .... Subfamily II. TRIDYMINÆ.
3. Antennæ 12–13-jointed; marginal vein always shorter than the subcostal, the costal cell normal; second abdominal segment often large but not especially lengthened; ovipositor not exserted; mesothoracic furrows most frequently complete .... Subfamily III. MISCOGASTERINÆ.
4. Antennæ 13–14-jointed, subclavate, inserted below the middle of the face; front wings with the marginal vein very long, usually fully as long as the subcostal vein; second abdominal segment much lengthened; ovipositor usually exserted; mesothoracic furrows incomplete; ♂ antennæ often verticellate-pilose .... Subfamily IV. LELAPINÆ.

SUBFAMILY I. PIRENINÆ.

1843. Pireniani, Tribus (partim), Haliday, Trans. Ent. Soc. London, III., p. 295.
1856. Pyrenoidæ, Familie (partim), Förster, Hym. Stud., II., pp. 18, 22 and 40.
1875. Pirenina, Tribus, Thomson, Hym. Skand., IV., pp. 12 and 187.
1886. Pireninæ, Subfamily (partim), Howard, Ent. Amer., I., p. 198.
1899. Pireninæ, Subfamily I., Ashmead, Proc. Ent. Soc. Washington, IV., p. 247.

This group is of small extent, although widely distributed. It is separated from the other subfamilies principally by the paucity of joints in the antennæ, and most of the species falling in it, whose parasitism is known, attack dipterous larvæ.

The genera *Calypso* and *Macroglenes* are easily separated by the different shaped heads in the males. Neither Haliday nor Thomson, however, give the characters to separate the females, and since I am only acquainted with *Macroglenes*, it has been impossible to give characters to separate the females.

TABLE OF GENERA.

1. Females 2
   Males 9
2. Eyes pubescent 3
   Eyes bare 5

3. Abdomen with the second segment occupying about one half the whole surface or only a little more.
   Antennæ 11-jointed, the scape long, slender, the pedicel at least as long as the club; marginal vein not more than *four* times the length of the stigmal vein..........**Erotolepsia** Howard (type *E. compacta* Howard).
   Antennæ 10-jointed, the scape short and slender, the pedicel shorter than the club; marginal vein long, about *six* times the length of the stigmal vein................**Herbertia** Howard (type *H. lucens* Howard).
5. Antennæ 10-jointed, with one or two ring-joints.
   Maxillary palpi 2-jointed.. 8
   Maxillary palpi 4-jointed.. 6
6. Ovipositor exserted.. 7
   Ovipositor *not* exserted.
   Postmarginal and stigmal veins very short.
   ?.....................................**Calypso** Haliday (type *C. serratulæ* Haliday).
   ?.........................**Macroglenes** Westwood (type *Ichneumon penetrans* Kirby).
7. Antennæ with *two* ring-joints; postmarginal and stigmal veins very short...........**Pirene** Haliday (type *P. varicornis* Hal.).
   Antennæ with *one* ring-joint; postmarginal and stigmal veins long.................**Ecrizotes** Förster (type *E. monticola* Förster).
8. Legs abnormal, the tibiæ strongly inflated or swollen, stouter than the femora, the tarsi short and slender, the joints very short; clypeus triangularly produced.......**Spathopus** Ashmead, gen. nov. (type *S. anomalipes* Ashm.).
9. Eyes pubescent.. 10
   Eyes bare... 11
10. Antennæ 11-jointed; marginal vein not more than *four* times the length of the stigmal, the latter with a distinct club...**Erotolepsia** Howard.
    Antennæ 10-jointed; marginal vein about *six* times the length of the stigmal vein. **Herbertia** Howard.
11. Antennæ 10-jointed, with one or two ring-joints.
    Maxillary palpi *two*-jointed... 13
    Maxillary palpi *four*-jointed.. 12
12. Eyes normal, not converging above...**Calypso** Haliday.
    Eyes abnormal, converging and nearly meeting above on the vertex..........**Macroglenes** Westwood.
13. Marginal vein *not* twice as long as the stigmal vein; flagellum not clavate.......... **Pirene** Haliday.
    Marginal vein about twice as long as the stigmal vein, thickened at the base; flagellum short, clavate, the joints of the funicle moniliform, pilose...................................**Ecrizotes** Förster.

Subfamily II. Tridyminæ.

1835. Ormoceridæ, Family (partim), Walker, Ent. Mag., II., p. 167.
1856. Ormoceroidæ, Familie 15 (partim), Förster, Hym. Stud., II., pp. 19 and 24.
1856. Hormoceroidæ, Familie 15 (partim), Förster, *opus cit.*, p. 59.
1875. Tridyminæ Tribus, (partim) Thomson, Hym. Skand. pp. 12 and 192.
1886. Tridyminæ, Subfamily, (partim) Howard, Ent. Amer., I., p. 198.
1899. Tridyminæ, Subfamily II., Ashmead, Proc. Ent. Soc. Washington, IV., p. 247.

This subfamily seems to be a natural group of gall-inhabiting species, allied to the *Pireninæ*, but easily separated by the structure of the antennæ.

Two tribes may be distinguished :

TABLE OF TRIBES.

Mesonotum with *complete*, distinct furrows..Tribe I. Tridymini.
Mesonotum with *incomplete* furrows, indicated only anteriorly.....................Tribe II. Metastenini

Tribe I. *Tridymini.*

The complete mesonotal furrows distinguish this tribe. Most of the species falling in this tribe are parasitic upon gall-making or gall-inhabiting Diptera, belonging to the family *Cecidomyiidæ*. *Æpocerus* Mayr, however, is a genus living parasitically upon fig-insects in Brazil, and one or two exotic genera attack other gall-inhabiting insects.

TABLE OF GENERA.

1. Females.. 2
   Males.. 15
2. Antennæ inserted near the mouth or just above the clypeus.................... 3
   Antennæ inserted on or near the middle of the face, far above the clypeus.... 8
3. Marginal vein normal.. 4
   Marginal vein abnormal, semicircularly thickened at the base......**Stigmatocrepis** Ashmead g. nov. (type *S. americana* Ashm.).
4. Clypeus at apex truncate or with a slight median sinus, never produced......... 5
   Clypeus at apex triangularly produced.
   Antennæ 12-jointed, the flagellum clavate, the joints of the funicle quadrate or transverse; abdomen ovate or conic ovate................**Tridymus** Ratzeburg (type *T. aphidum* Ratz.).
5. Head and thorax *not* umbilicately punctate, at the most finely punctate, shagreened or rugulose, sometimes smooth... 6
   Head and thorax umbilicately punctate.
   Front wings hyaline, sometimes with a smoky discoidal cloud, the marginal vein much longer than the stigmal, the latter with an upward curve, the first marginal vein not longer than the stigmal; antennæ 13-jointed with 2 ring-joints, the pedicel not long.
   Decatomothorax Ashmead g. nov. (type *D. gallicola* Ashm.).
6. Head and thorax finely punctate or shagreened, rarely smooth...................... 7
   Head and thorax finely rugulose; marginal vein not longer than the stigmal vein, the latter straight, but oblique, not curved, postmarginal vein longer than the stigmal; antennæ 13-jointed, with 2 ring-joints, the pedicel large, as long as or a little longer than the ring-joints and the first joint of the funicle united..................**Alloderma** Ashmead g. nov. (type *A. maculipennis* Ashm.).
7. Abdomen conically produced, the ovipositor exserted; antennæ 12-jointed, the funicle joints transverse; marginal vein more than twice the length of the stigmal vein.....**Gastrancistrus** Westwood. (type *G. vagans* Westw.).
   Abdomen short oval, above depressed, beneath boat-shaped; antennæ 13-jointed, the funicle 6-jointed, the joints short, nearly cup-shaped..**Oxyglypta** Förster.

8. Front wings normal 9
Front wings with the portion comprising the costal cell dilated and obliquely truncate at the juncture of the submarginal vein with the marginal.
Antennæ 13-jointed, the flagellum dilated, the joints of funicle transverse, subpedunculate.
Epicopterus Westwood (type *E. choreiformis* Westw.).
9. Antennæ 13-jointed, with 2 or 3 ring joints 13
Antennæ 11- or 12-jointed 10
10. Thorax at most sparsely punctate, or almost smooth 11
Thorax slightly rugulosely punctate; antennæ 12-jointed; marginal vein about twice as long as the stigmal . . . . **Syntasis** Walker (type *S. encyrtoides* Walk.).
11. Wings *with* marginal ciliæ 12
Wings *without* marginal ciliæ.
Antennæ 12-jointed, with *one* ring-joint . . . . b
Antennæ 11- or 12-jointed, with *two* ring-joints.
Antennæ 11-jointed; abdomen as long as the head and thorax united, compressed.
Syntomocera Förster (type *S. clavicornis* Först.).
Antennæ 12-jointed; abdomen elongated, usually compressed and carinate beneath.
Asematus Förster (type *A. amphibolus* Först.).
b. Abdomen oblong, fully as long as the head and thorax united; head short, subconvex in front; mesonotum not short, the furrows deep. **Cecidoxenus** Ashm. g. nov. (type *C. nigrocyaneus* Ashm.).
12. Antennæ 13-jointed, subclavate, the joints of the funicle, except the first, quadrate or nearly; metathorax short with a median carina, the spiracles small, oval; head with sparse, thimble-like punctures; abdomen conic-ovate . . . . **Semiotellus** Westwood (type *Semiotus mundus* Walk.).
13. Antennæ with *two* ring-joints 14
Antennæ with *three* ring-joints.
Abdomen depressed, the ovipositor subexserted, never very long, at the most one third the length of the abdomen, usually shorter . . . . **Æpocerus** Mayr (type *Æ. excavatus* Mayr).
14. Metathorax short, *with* a median carina; abdomen compressed, above depressed, beneath keeled.
Terobia Förster (type *T. dispila* Först.).
Metathorax very short, *without* a median carina; abdomen subglobose or short oval; flagellum subclavate, the pedicel large, the joints of the funicle small, submoniliform, increasing in size towards the club . . . . **Paraterobia** Ashmead g. nov. (type *P. nigriceps* Ashm.).
15. Antennæ inserted near the mouth or just above the clypeus 16
Antennæ inserted on or near the middle of the face, far above the clypeus 21
16. Marginal vein normal 17
Marginal vein abnormal, semicircularly thickened at the base . . . . **Stigmatocrepis** Ashmead.
17. Clypeus at apex truncate or with a slight median sinus, never produced 18
Clypeus at apex triangularly produced.
Antennæ 12-jointed, the flagellum filiform, pubescent or hairy, the funicle joints quadrate or transverse quadrate, losely joined . . . . **Tridymus** Ratzeburg.
18. Head and thorax not umbilicately punctate, at the most finely punctate, shagreened or rugulose, sometimes smooth 19
Head and thorax umbilicately punctate.
Antennæ 13-jointed with *two* ring-joints . . . . **Decatomothorax** Ashmead.
19. Head and thorax finely punctate or shagreened, rarely smooth 20

Head and thorax finely rugulose; marginal vein not longer than the stigmal, the latter straight but oblique, not curved, postmarginal vein longer than the stigmal; antennæ 13-jointed with *two* ring-joints. . . . . **Alloderma** Ashmead.

20. Antennæ 12-jointed. . . . . **Gastrancistrus** Westwood.

Antennæ 13-jointed . . . . **Oxyglypta** Förster.

21. Front wings normal. 22

Front wings abnormal, the portion comprising the costal cell dilated and obliquely truncate at the juncture of the submarginal vein with the marginal; antennæ 13-jointed. . . . **Epicopterus** Westwood.

22. Antennæ 13-jointed, with *two* or *three* ring-joints. 26

Antennæ 11- or 12-jointed. 23

23. Thorax at most sparsely punctate or nearly smooth. 24

Thorax slightly rugulosely punctate; antennæ 12-jointed. . . . . **Syntasis** Walker.

24. Wings *with* marginal ciliæ 25

Wings *without* marginal ciliæ.

Antennæ 12-jointed with *one* ring-joint. . . . . **Cecedoxenus** Ashmead.

Antennæ 11- or 12-jointed with *two* ring-joints.

Antennæ 11-jointed, with *two* ring-joints . . . . **Syntomocera** Förster.

Antennæ 12-jointed, with *two* ring-joints. . . . . **Asematus** Förster.

25. Antennæ 13-jointed. . . . . **Semiotellus** Westwood.

26. Antennæ with *two* ring-joints. 27

Antennæ with *three* ring-joints. . . . . **Æpocerus** Mayr.

27. Metathorax short, with a median carina. . . . . **Terobia** Förster.

Tribe II. *Metastenini.*

The species falling in this tribe are easily separated from those in the tribe *Tridymini* by mesonotal characters, the parapsidal furrows being incomplete.

TABLE OF GENERA.

1. Females. 2

Males 11

2. Antennæ 12-jointed, with *two* ring-joints. 3

Antennæ 13-jointed, with *two* ring-joints. 4

3. Flagellum incrassated; mandibles 3-dentate, the malar space not large; metanotum short, smooth, with a distinct median carina, the spiracles small; marginal vein longer than the stigmal vein, the postmarginal very long. . . . . **Metastenus** Walker (type *M. concinus* Walk.).

Flagellum at the most subclavate, the club 3-jointed; mandibles (?) 4-dentate, the malar space large; axillæ widely separated; metanotum punctate, with a median carina; marginal vein thickened, as long as the stigmal vein, the postmarginal longer. . . . . **Disema** Förster (type *D. pallipes* Förster).

4. Tip of antennæ normal, not ending in a spine. 5

Tip of antennæ ending in a spine, as in *Rhaphiteles* Walk., the flagellum long and slender, the funicle joints all long; left mandible 3-, the right 4-dentate; metathorax not short, without a median carina, the spiracles large, oval; abdomen large, depressed, very much longer than the head and thorax united . . . . **Stylophorella** Ashmead, g. nov. (type *S. perplexa* Ashm.).

5. Pronotum not distinctly separated 6

Pronotum distinctly separated. 8

6. Funicle filiform, the first joint large.
   Marginal vein slender, always longer than the stigmal vein; abdomen ovate................ 7
   Marginal vein *thickened*, not longer than the stigmal vein.
   Body short; clypeus bidentate; mandibles 3-dentate...............**Xenocrepis** Förster (type *Cænocrepis arenicola* Thoms.).
7. Abdomen with a yellow band at base; metathorax short, *with* a median carina and lateral folds; clypeus separated, anteriorly arcuate............**Dimachus** Thomson (type *Pteromalus discolor* Walk.).
   Abdomen *without* a yellow band at base; metathorax not short, *without* a median carina; clypeus separated, smooth, with a median tooth anteriorly. .**Hemitrichus** Thomson (type *H. rufipes* Thoms.).
8. Flagellum with the first joint short.. 9
   Flagellum with the first joint long, cylindrical.. 10
9. Antennæ short, clavate in both sexes, inserted a little below the middle of the face; clypeus at apex truncate; metathorax rather short, *without* lateral folds, the spiracles rounded....**Habritus** Thomson (type *Pteromalus brevicornis* Ratzeburg).
   Antennæ filiform, inserted on the middle of the face; clypeus at apex with a median incision; metathorax not long, *without* a median carina, spiracles large, nearly linear.........**Dinarmus** Thomson (type *D. acutus* Thoms.).
10. Antennæ filiform, inserted on the middle of the face, the funicle joints all longer than thick; clypeus anteriorly with a median sinus; metathorax not short, without lateral folds, median carina, or spiracular sulci, the spiracles oval.............**Arthrolysis** Förster (type *Pteromalus scabriculus* Nees).
11. Antennæ 12-jointed, with *two* ring-joints... 12
    Antennæ 13-jointed, with *two* ring-joints... 13
12. Marginal vein not thickened, longer than the stigmal vein; metanotum short, smooth but with a distinct median carina, the spiracles small....................................**Metastenus** Walker.
    Marginal vein thickened, *not* longer than the stigmal vein; metanotum punctate, with a median carina...**Disema** Förster.
13. Pronotum not distinctly separated.. 14
    Pronotum distinctly separated.. 16
14. Marginal vein slender, always longer than the stigmal vein..................................... 15
    Marginal vein *thickened*, not longer than the stigmal vein.
    Clypeus bidentate; mandibles 3-dentate................................**Xenocrepis** Förster.
15. Metathorax short, *with* a median carina.......................................**Dimachus** Thomson.
    Metathorax *not* short, *without* a median carina..............................**Hemitrichus** Thomson.
16. Antennæ inserted on the middle of the face, long... 17
    Antennæ inserted somewhat below the middle of the face.......................**Habritus** Thomson.
17. Metathorax without a median carina, the lateral folds *present*, the spiracles large, nearly linear. **Dinarmus** Thomson.
    Metathorax without a median carina, the lateral folds *absent*, the spiracles oval. **Arthrolysis** Förster.

Subfamily III. MISCOGASTERINÆ.

1833. Miscogasteridæ, Family IV (partim), Walker, Ent. Mag., I., p. 370.

1835. Ormoceridæ, Family (partim), Walker, Ent. Mag., I., p. 167.

1835. Pteromalidæ, Family (partim), Walker, Ent. Mag., II., p. 286.

1856. Miscogasteroidæ, Family XIV (partim), Förster, Hym. Stud., II., pp. 19, 24 and 59.
1875. Pteromalina, Tribus (partim), Thomson, Hym. Skand., IV., pp. 12 and 216.
1885. Pteromalinæ, Subfamily (partim), Howard, Ent. Amer., I., p. 198; II., 1886, p. 33.
1885. Mischogastrides, Subtribus Thomson, Hym. Skand., IV., pp. 16 and 219.
1886. Mischogastrides, Tribe, Howard, Ent. Amer., II., p. 33.

This subfamily, although distinct, has affinities which ally it with the families *Perilampidæ* and the *Eucharidæ*, and also with the *Pteromalidæ*, through the subfamily *Sphegigasterinæ*. From the last mentioned it is separated by the *two*-spurred hind tibiæ, from the others by the cephalic, thoracic and abdominal differences brought out in my tables.

Two tribes may be recognized:

TABLE OF TRIBES.

Mesonotum with the parapsidal furrows *incomplete*, indicated only anteriorly; clypeus transverse, sublunate, the anterior margin narrowly incised medially......................Tribe I. Halticopterini.
Mesonotum with the parapsidal furrows *complete*; clypeus not transverse.....Tribe II. Miscogasterini.

Tribe I. *Halticopterini.*

The incomplete mesonotal furrows are sufficient to distinguish the tribe. The group is apparently parasitic upon Diptera belonging to the family *Anthomyiidæ*, and some are recorded from Lepidoptera and Hymenoptera. These latter records, however, are questionable and, additional evidence is needed before the true parasitism of these insects is definitely settled.

Many insects are found associated with the wood-boring Coleoptera, gall-making Diptera, Hymenoptera, Lepidoptera, etc., and it is not easy to tell correctly the host from which you breed several parasites.

TABLE OF GENERA.

1. Females.. 2
   Males.. 3
2. Clypeus transverse, sublunate, the anterior margin narrowly incised medially.
   Marginal vein longer than the stigmal, the latter ending in a small knob; mandibles strong, 4-dentate............................**Halticoptera** Spinola (type *Diplolepis flavicornis* Spin.).
   Marginal vein usually not longer than the stigmal, the latter with a small knob; mandibles not strong, but 4-dentate, the upper tooth bent, the lower straight..............**Dicylus** Walker (type *D. lynastes* Walk.).
3. Palpi abnormal; marginal vein longer than the stigmal.......................**Halticoptera** Spinola.
   Palpi normal; marginal vein usually shorter than the stigmal or no longer............**Dicylus** Walker ? = *Tityros* Walk. ♂.

Tribe II. *Miscogasterini.*

This tribe may be recognized by the *complete* mesonotal furrows; otherwise it is practically identical with the previous tribe, with similar habits.

TABLE OF GENERA.

1. Females 2
   Males 9
2. Pronotum not distinctly separated 3
   Pronotum distinctly separated.
   Mesothoracic lobes not convex; abdomen elongate, subcompressed, the petiole short. **Toxeuma** Walker (type *T. ericæ* Walk.).
3. Mesothoracic lobes flat or at most subconvex, the furrows not deep, delicately impressed posteriorly. 4
   Mesothoracic lobes convex, the furrows deep 5
4. Metathorax long, rugose, with a median carina and complete lateral folds; scutellum with a more or less distinct cross-furrow before apex, the lateral margins convergent toward base. **Megorismus** Walker (type *M. aon* Walk.).
   Metathorax short, almost smooth, with a distinct median carina; scutellum with the lateral margins nearly straight, not or only slightly convergent toward base .... **Ormocerus** Walker (type *O. latus* Walk.).
5. Petiole long; both mandibles 4-dentate 8
   Petiole short or moderate; mandibles variable.
   Left mandible 3-dentate, the right 4-dentate 6
   Both mandibles alike, either 3- or 4-dentate 7
6. Petiole rugose or smooth; front wings with the stigmal vein ending in a *small* knob. **Lamprotatus** Westwood (type *L. splendens* Westw.).
   Petiole punctate, subdepressed; front wings with the stigmal vein ending in a *large* knob.
   Dorsum serico-punctate .... **Gitognathus** Thomson (type *Sphæropalpus viridis* Först.).
   Dorsum squamo-punctate .... **Stictomischus** Thomson (type *S. scaposus* Thoms.).
7. Both mandibles 3-dentate; stigmal knob *small;* clypeus transverse, separated, the anterior margin truncate .... **Seladerma** Walker (type *S. lætum* Walk.).
   Both mandibles 4-dentate; stigmal knob *large* .... **Miscogaster** Walker (type *M. hortensis* Walk.).
8. Stigmal vein ending in a large knob .... **Miscogaster** Walker.
9. Pronotum not distinctly separated 10
   Pronotum distinctly separated.
   Both mandibles 4-dentate; flagellum hairy, the first joint not longer than wide; mesothoracic lobes not convex .... **Toxeuma** Walker.
10. Mesothoracic lobes convex, the furrows deep 11
    Mesothoracic lobes flat or at most subconvex, the furrows not deep, delicately impressed posteriorly.
    Metathorax long, rugose, with a median carina and complete lateral folds; scutellum with a cross-furrow before apex, the lateral margins convergent toward base .... **Megorismus** Walker.
    Metathorax short, almost smooth, with a distinct median carina; scutellum with the lateral margins nearly straight .... **Ormocerus** Walker.
11. Petiole long or short; both mandibles 4-dentate 14
    Petiole short; both mandibles 3-dentate, or the left is 3-dentate, the right 4-dentate.
    Left mandible 3-, the right 4-dentate 12
    Both mandibles 3-dentate 13

12. Stigmal vein ending in a *small* knob; palpi normal........................**Lamprotatus** Westwood.
Stigmal vein ending in a *large* knob.
Palpi abnormal..**Gitognathus** Thomson.
Palpi normal..**Stictomischus** Thomson.
13. Stigmal vein ending in a small knob; palpi normal.............................**Seladerma** Walker.
14. Stigmal vein ending in a large knob..**Miscogaster** Walker.

Subfamily IV. Lelapinæ.

1899. Lelapinæ, Subfamily IV., Ashmead, Proc. Ent. Soc. Washington, IV., p. 247.
1901. Lelapinæ, Subfamily IV., Ashmead, Faun. Hawaiiensis, I., p. 311.

This group reaches its greatest development in South America, where the species of *Lelaps* are numerous, although as yet only a few have been described.

The group is, I think, correctly placed in the family *Miscogasteridæ.* It shows some affinities with the *Cleonymidæ,* and with the *Pteromalidæ,* through the subfamily *Diparinæ.* The two spurred hind tibiæ, however, separate it from the latter, while other characters separate it from the *Cleonymidæ.*

The metathorax at apex is most frequently contracted into a neck, the usually conically produced abdomen being attached to this neck by a short petiole. The mesonotal furrows are complete; the axillæ are usually approximate, although separated at base of the scutellum, while the head, especially in the genus *Lelaps,* resembles somewhat that found among the *Cleonymidæ,* the eyes being large and the occiput flat.

My recently characterized genus *Apterolelaps* is from North American, and superficially resembles *Philachyra* Haliday, a genus in the *Eurytomidæ.*

TABLE OF GENERA.

1. Females.. 2
Males.. 6
2. Antennæ 14-jointed with 2 ring-joints.. 3
Antennæ 12- or 13-jointed.. 5
3. Winged.. 4
Apterous.
Abdomen conically pointed, the petiole distinct, a little longer than thick, the second segment occupying hardly half its surface; flagellum rather stout, subclavate, the joints fluted.
Apterolelaps Ashmead (type *A. nigriceps* Ashm.).
4. Abdomen conically produced at apex, and usually ending in a prominent ovipositor; second segment large, occupying fully half the surface, the third to fifth very short, the sixth and seventh together conical, longer than half the length of the second. **Lelaps** Haliday (type *Merostenus sodales* Walk.).
5. Abdomen conically produced at apex, the second segment not much longer than the third and fourth united, the fifth longer than the fourth, the seventh conically produced; scutellum with a cross-furrow at its apical third..............................**Neolelaps** Ashmead (type *N. hawaiiensis* Ashm.).

Abdomen subglobose or short oval, the second segment very large, occupying nearly the whole surface, the following very short, more or less retracted within the second; scutellum with a cross-furrow very near its apex .... **Mesolelaps** Ashmead (type *M. cyaneiventris* Ashm.).

6. Petiole of abdomen long, the body small, spatulate; antennæ very long, 14-jointed, longer than the whole body, the joints long, cylindrical, clothed with long, sparse hairs .... **Lelaps** Haliday.

   Petiole of abdomen very short, the body oblong-oval, truncate at apex; antennæ not longer than the thorax, 13-jointed, the flagellum filiform, pubescent, the joints after the first about twice as long as thick .... **Mesolelaps** Ashmead.

Family LXVII. CLEONYMIDÆ.

1837. Cleonymidæ, Family (partim), Walker, Ent. Mag., IV., p. 349.

1846. Eupelmidæ, Family 9 (partim), Walker, List Chalcid. Brit. Museum, I., p. 52.

1856. Cleonymoidæ, Familie XIV. (partim), Förster, Hym. Stud., II., pp. 19, 24 and 46.

1875. Cleonymides, Subtribus, Thomson, Hym. Skand., IV., p. 217.

1878. Cleonymides, Subtribus, Thomson, Hym. Skand., V., p. 3.

1886. Cleonymides, Tribe, Howard, Entom. Amer., II., pp. 33, 34.

1899. Cleonymidæ, Family LXVI., Ashmead, Proc. Ent. Soc. Washington, IV., p. 200.

An historical sketch of this family was given in my paper entitled: "On the Genera of the Cleonymidæ," published in 1899.

Unquestionably, the family comes nearest to the family *Encyrtidæ*, and forms a connecting link between it and some families previously treated, *i. e.*, the *Chalcididæ*, *Eurytomidæ* and the *Miscogasteridæ;* some genera in the subfamily *Chalcedectinæ* especially being remarkably like some genuine *Chalcididæ*. Many males, too, are easily mistaken for genuine *Eupelmines* and *Encyrtines*. *Pelecinella* has some characters similar to the *Eurytomidæ*, and the *Torymidæ*.

Coleotrechnus, placed in this family, is unknown to me. It is placed here from the description alone, and may be a genuine Encyrtid, although nothing is said of a saltatorial middle tibial spur.

TABLE OF SUBFAMILIES.

1. Mesonotal furrows not at all indicated 4

   Mesonotal furrows more or less distinct 2

2. Abdomen longly petiolated 3

   Abdomen sessile, or subpetiolate, never longly petiolate.

   Posterior femora much swollen and usually toothed or finely denticulate beneath, as in *Chalcis*, *Smicra*, etc.; abdomen usually depressed, the ovipositor rarely exserted; antennæ at the most 11. jointed .... Subfamily I. CHALCEDECTINÆ.

   Posterior femora not much swollen and very rarely toothed beneath, the anterior femora usually more or less enlarged, sometimes very much swollen and often excised or dentate beneath toward apex; ovipositor often, but not always, exserted; antennæ 11–13-jointed. Subfamily II. CLEONYMINÆ.

3. Body of abdomen strongly compressed, sword-shaped, ending in a long ovipositor, the basal sheaths very broad; all legs slender, the hind pair very long, their coxæ long, cylindrical; front wings with the marginal and postmarginal veins very long, the latter extending to tip of wing, the stigmal vein very small, subsessile; antennæ 11-jointed, inserted close to the mouth. . Subfamily III. PELECINELLINÆ.
4. Abdomen subsessile, compressed, conically produced toward apex; front wings with the postmarginal and stigmal veins very short, the knob of the latter nearly sessile, rounded; posterior tibiæ compressed, the hind margin denticulate . . . . Subfamily IV. COLOTRECHNINÆ.

SUBFAMILY I. CHALCEDECTINÆ.

1889. Polychromminæ, Subfamily, Ashmead, Proc. Ent. Soc. Washington, I., p. 226.
1895. Chalcedectinæ, Subfamily, Ashmead, Proc. Ent. Soc. Washington, III., p. 230.
1898. Chalcodectinæ, Subfamily, Dalla Torre, Cat. Hym., V., p. 186.
1899. Chalcedectinæ, Subfamily I., Ashmead, Proc. Ent. Soc. Washington, IV., p. 201.

The sessile abdomen and the greatly swollen and usually dentate or serrate hind femora, as in the *Chalcididæ*, distinguish the family. It is not represented in Europe and has reached its greatest development in South America and Australia, where the species are evidently numerous. I have also seen an undescribed species from Africa, where it should be well represented.

TABLE OF GENERA.

1. Females 2
   Males 7
2. Hind femora much swollen, minutely denticulate beneath 5
   Hind femora much swollen and armed beneath with large, distinct teeth, or at least with *one* large tooth.
   Hind femora armed with 1 to 3 large teeth 3
   Hind femora armed with several teeth.
   Abdomen depressed, the fourth dorsal segment the largest, transversely striate or aciculate-
   Chalcedectes Walker (type *C. maculicornis* Walker).
3. Hind femora with *one* large tooth, with three or four smaller teeth beyond 4
   Hind femora with *three* large teeth . . . . **Cleptimorpha** Walker (type *C. binotata* Walker)
4. Abdomen oblong-oval, subcompressed beneath, nearly bare, and ending in a long ovipositor; head and thorax coarsely reticulately punctate; flagellum long, slender, filiform. . . . . . **Chalcidiscelis** Ashmead (type *C. koebelei* Ashm.).
   Abdomen shorter than the thorax, compressed, the ovipositor hidden; mesonotum nearly smooth, or transversely striate or wrinkled; antennæ 12-jointed, the funicle 6-jointed, the joints transverse.
   Systolomorpha Ashmead (type *S. thyridopterygis* Ashm.).
5. Antennæ 11-jointed 6
   Antennæ 10-jointed . . . . **Amotura** Cameron (type *A. annulicornis* Cam.).
6. Abdomen ovate or conic-ovate.
   Abdomen not depressed, convex beneath, the fourth dorsal segment longer than the third, the latter a little longer than the fifth; metathoracic spiracles reniform. **Agamerion** Haliday[1] (type *Miscogaster gelo* Walk.).
   Abdomen depressed, flat above and beneath, the third and fourth dorsal segments short, united shorter than the fifth; stigmal vein rather short; metathoracic spiracles oval.
   Euchrysia Westwood (type *E. cleptidea* Westw.).

[1] Kirby has incorrectly classified this genus with the *Chalcidinæ*.

7. Hind femora much swollen, minutely denticulate beneath.. 10
   Hind femora much swollen and armed beneath with large, distinct teeth or at least with one large tooth.
      Hind femora armed with 1 to 3 large teeth.. 8
      Hind femora armed with several teeth.................................. **Chalcedectes** Walker.
8. Hind femora with *one* large tooth.. 9
   Hind femora with *three* large teeth...................................... **Cleptimorpha** Walker.
9. Head and thorax coarsely, reticulately punctate.......................... **Chalcidiscelis** Ashmead.
   Head and thorax not coarsely reticulately punctate, the mesonotum almost smooth.
   Systolomorpha Ashmead.
10. Antennæ 11-jointed 11
    Antennæ 10-jointed.. **Amotura** Cameron.
11. Metathoracic spiracles reniform... **Agamerion** Haliday.
    Metathoracic spiracles oval.. **Euchrysia** Westwood.

Subfamily II. Clennyminæ.

1897. Cleonyminæ, Subfamily II, Ashmead, Proc. Ent. Soc. Washington, iv, pp. 201, 202.

To this group belong the better known genera of the family, namely *Cleonymus*, *Cheiropachys*, *Trigonoderus*, *Acrocormus*, etc., genera of world-wide distribution. It is the largest group of the family and includes many genera and species. Most of the species appear to attack only coleopterous larvæ and are of great economic importance, since they destroy beetles destructive to our fruit, shade and forest trees.

TABLE OF GENERA.

1. Females 2
   Males 23
2. Anterior femora more or less distinctly swollen, and never excised dentate beneath................. 18
   Anterior femora much swollen, or excised dentate beneath... 3
3. Pronotum not much narrowed and always wider than long.. 4
   Pronotum much lengthened and narrowed, longer than wide.
      Front femora greatly swollen, but not excised dentate beneath; abdomen conically produced, but not much longer than the head and thorax united.
      Heydenia Förster (type *H. pretiosa* Förster).
      Front femora much swollen, and excised dentate beneath; abdomen elongate, conically produced.
      Lycisca Spinola (type *L. raptoria* Spinola).
4. Eyes bare 1
   Eyes pubescent.
      Ovipositor very long... 6
      Ovipositor not prominent, at the most subexserted.
         Abdomen subrotund, oblong or conic-ovate, the sides rounded, not carinated.......... 5
         Abdomen conic-ovate, or conically lengthened, the sides distinctly carinated.
         Epistenia Westwood (type *E. cœrulea* Westw.).

5. Labrum inconspicuous or hidden 7
Labrum conspicuous.
Abdomen conic-ovate .... **Cleonymus** Latreille (type *Ichneumon depressus* Fabr.).
Abdomen subrotund; antennæ 12-jointed, with *three* ring-joints .... **Micradelus** Walker (type *M. rotundus* Walk.).
6. Abdomen with the first and fifth segments the longest; antennæ 11-jointed........ **Belonea** Westwood (type *B. australica* Westw.).
Abdomen with the first segment longer than the three following, the third produced into a sharp triangular point at the middle; antennæ 9-jointed...... **Cameronella** Dalla Torre, = *Panthalis* Cameron (type *P. blackburnii* Cam.).
7. Abdomen oblong or long-ovate; mesonotum with the furrows only slightly indicated anteriorly; fifth abdominal segment nearly as long as the first four segments united, the second and the third together hardly longer than the fourth, the first and fourth subequal; front wings maculate.
Ptinobius Ashmead (type *Charitopus magnificus* Ashm.).
8. Winged 9
Apterous.
Abdomen ovate, ending in a long ovipositor; antennæ 13-jointed, with *three* ring-joints.
Cea Haliday (type *C. pulicaria* Haliday).
9. Abdomen conic-ovate, or conical, the terminal segment tubular, the ovipositor very long........ 10
Abdomen as seen from above rotund, compressed or carinate beneath.
Front wings hyaline, the stigmal vein hardly two thirds the length of the marginal, and a little shorter than the postmarginal; metathorax with lateral folds, the spiracles oval-elliptic.
Tomicobia Ashmead (type *T. tibialis* Ashm.).
Abdomen conic-ovate, the segments subequal, the ovipositor not exserted.
Front wings *with* two transverse bands or maculæ; pronotum transverse-quadrate, narrowed medially; pedicel not lengthened .... **Cheiropachys** Westwood (type *Sphex colon* Linné).
Front wings *without* bands or maculæ; pronotum transverse-quadrate, but not narrowed medially and well separated; pedicel much lengthened........ **Schizonotus** Ratzeburg (type *S. sieboldii* Ratzeb.).
10. Last two abdominal segments very long, tubular. **Thaumasura** Westwood (type *T. terebrator* Westw.).
Last five abdominal segments very slender, tubular. **Solenura** Westwood (type *S. telescopica* Westw.).
11. Mesothoracic furrows complete 16
Mesothoracic furrows incomplete, indicated only anteriorly.
Pronotum short, narrowed medially 12
Pronotum very long, conical 15
12. Marginal vein not thickened 13
Marginal vein thickened, shorter than the postmarginal. **Zapachia** Förster (type *Z. spiloptera* Först.).
13. Abdomen oval, hardly as long as the thorax, above depressed 14
Abdomen conical, longer than the thorax, the segments after the first, which is the longest, subequal.
Front wings *with* one transverse band, the stigmal club large........ **Acrocormus** Förster (type *A. semifasciatus* Thoms.).
Front wings *without* a band, the stigmal club small. **Caudonia** Walker (type *C. agylla* Walk.).
14. Front wings with a large, broad fuscous band beneath, the marginal and stigmal veins having a triangular hyaline streak within from the marginal vein; stigmal vein long, subclavate, as long as the marginal; funicle joints 3 to 6 a little wider than long........ **Brachycaudonia** Ashmead g. nov. (type *B. californica* Ashm.).

15. Abdomen ovate, shorter than the thorax, the segments subequal; middle tarsi incrassate. **Notanisus** Walker (type *N. versicolor* Walk.).
16. Abdomen sessile 17
Abdomen petiolate 22
17. Abdomen elongate, conically produced or acuminate at apex; postmarginal vein well developed. 18
Abdomen long, conic-ovate, ending in a prominent ovipositor, which is dilated into three broad, leaf-like expansions, like a propeller in a naphtha launch. **Dinoura** Ashmead (type *D. auriventris* Ashm.).
18. Scutellum *without* a transverse grooved line before tip; head triangular, narrowed anteriorly 21
Scutellum *with* a transverse grooved line before the tip; head with rounded, convex cheeks.
Pronotum transverse, not large 19
Pronotum large, almost quadrate . . . . **Merostenus** Walker (type *M. phedyma* Walk.).
19. Pronotum very short, visible from above as a fine transverse line 20
Pronotum transverse . . . . **Trigonoderus** Westwood (type *T. princeps* Westw.).
20. Antennæ 13-jointed; middle tibiæ normal; metanotum with a sharp median carina. **Anoglyphis** Förster (type *A. nubilosa* Först.).
Antennæ 14-jointed; middle tibiæ much lengthened. **Macromesus** Walker (type *M. amphiretus* Walk.).
21. Middle tibiæ not dilated at apex . . . . **Platygerrhus** Thomson (type *P. gracilis* Thoms.).
Middle tibiæ dilated at apex, their tarsi broad at base . . . . **Pegopus** Förster (type *Prosopon montanus* Walk.).
22. Scutellum *without* a transverse grooved line before tip . . . . **Photismus** Thomson (type *P. nubilosus* Thoms.).
23. Front femora not, or less distinctly, swollen, and never excised dentate beneath 28
Front femora much swollen, and sometimes excised dentate beneath.
Pronotum not much narrowed and always wider than long 24
Pronotum much narrowed and lengthened.
Front femora much swollen but not excised dentate beneath; abdomen clavate, depressed . . . . **Heydenia** Förster.
Front femora swollen and excised dentate beneath . . . . **Lycisca** Spinola.
24. Eyes bare 27
Eyes pubescent.
Abdomen not carinate along the sides 25
Abdomen carinate along the sides . . . . **Epistenia** Westwood.
25. Labrum inconspicuous or hidden 26
Labrum conspicuous.
Metathorax *with* a median carina, the spiracles large, oblong or oval; flagellum subclavate, densely hairy, the joints of the funicle wider than long . . . . **Cleonymus** Latreille.
Metathorax *without* a median carina, the spiracles small, rounded; flagellum long, filiform, densely hairy, the joints of the funicle long . . . . **Micradelus** Walker.
26. Front wings bifasciate or maculate; marginal vein slender, about twice as long as the stigmal; pronotum not short; metanotum with a median carina; head lenticular, much wider than the thorax. **Ptinobius** Ashmead.
27. Front wings bifasciate; marginal vein not longer than the stigmal, the latter long, strongly clavate; pronotum short, transverse, slightly narrowed; metanotum with a short median carina, the spiracles elliptic; head transverse; pedicel shorter than the first joint of the funicle. **Cheiropachys** Westwood.
Front wings hyaline, not fasciate; marginal vein longer than the stigmal, the latter not especially long, ending in a small knob; pronotum large, quadrate, well-separated . . . . **Schizonotus** Ratzeberg.

28. Mesonotum with the furrows complete.. 30
Mesonotum with incomplete furrows, indicated only anteriorly.
Marginal vein not thickened.. 29
Marginal vein thickened, shorter than the postmarginal..................**Zapachia** Förster.
29. Wings with a transverse band or fascia.
Stigmal club very large..**Acrocormus** Förster.
Stigmal club small..**Brachycaudonia** Ashmead.
Wings hyaline, without a fascia.
Stigmal club small..**Caudonia** Walker.
30. Abdomen petiolate.. 34
Abdomen sessile.
Scutellum *with* a transverse grooved line before apex..................................... 31
Scutellum *without* a transverse grooved line before apex.................................. 32
31. Pronotum very short, visible from above as a fine transverse line........................ 32
Pronotum not very short.
Pronotum quadrate...**Merostenus** Walker.
Pronotum transverse..**Trigonoderus** Westwood.
32. Metanotum not short, smooth and with a sharp median carina; antennæ 13-jointed.
Anoglyphis Förster.
Metanotum very short, closely punctate; antennæ 14-jointed..................**Macromesus** Walker.
32. Postmarginal vein well developed...33
Postmarginal vein scarcely longer than the short stigmal vein with its knob; scutellum with two parallel dorsal grooved lines; metanotum with a median carina; antennæ..........**Dinoura** Ashmead.
33. Middle tibiæ not dilated at apex...................................**Platygerrhus** Thomson.
Middle tibiæ dilated at apex, the tarsi much thickened at base..................**Pegopus** Förster.
34. Scutellum without a transverse grooved line before the tip.....................**Photismus** Thomson.

Subfamily III. Pelecinellinæ.

1897. Pelecinellinæ, Subfamily III., Ashmead, Proc. Ent. Soc. Washington, IV., p. 201.

This subfamily is at present represented by a single genus, *Pelecinella* Westwood. Three species have been described, all from Brazil, and these are the largest and in some respects the most striking looking Chalcid-flies known.

The affinities of the group were discussed in my paper, "On the Genus *Pelecinella* Westwood," published in 1897.

Form very elongate; pronotum very long, longer and narrower than the mesonotum, contracted in front; head with a deep frontal furrow; abdomen long, compressed, lanceolate, ending in a long ovipositor, and longly petiolate; hind legs long, the coxæ long and cylindrical, the tibiæ longer than the femora, very gradually widened toward apex and terminating in two spurs, the tarsi slender, as long as the femora, the first joint longer than joints 2-5 united; stigmal vein very short, the marginal vein long, the postmarginal longer than the marginal........................**Pelecinella** Westwood (type *B. phantasma* Westw.).

Subfamily IV. Colotrechninæ.

1875. Colotrechnides, Subtribus, Thomson, Hym. Skand., IV., p. 217.

1878. Colotrechnides, Subtribus, Thomson, Hym. Skand., V., p. 46.

1886. Colotrechnides, Tribe, Howard, Ent. Amer., II., pp. 33 and 34.
1897. Colotrechninæ, Subfamily IV, Ashmead, Proc. Ent. Soc. Washington, IV., p. 201.

This group is unknown to me in nature. It is based upon Thomson's genus *Colotrechnus*, occurring in Sweden, who called it a subtribe.

Thomson's description clearly indicates that it belongs to the family *Cleonymidæ*, although the absence of mesonotal furrows is strongly suggestive of the *Encyrtidæ*.

Wings with the stigmal and postmarginal veins very short, the knob of the former rounded, subsessile; frontal depression long; antennæ 12-jointed, inserted below the middle of the face, the funicle 5-jointed; hind tibiæ compressed, the hind margin denticulate. . **Colotrechnus** Thomson (type *C. subcœrulens* Thoms.).

Family LXVIII. ENCYRTIDÆ.

1837. Encyrtidæ, Family (partim), Walker, Ent. Mag., IV., p. 439.
1840. Encyrtidæ, Subfamily 4, Westwood, Intro. Mod. Classif. Ins., II., p. 166; Synop., p. 66.
1846. Eupelmidæ, Family 9 (partim), Walker, List Chalc. Brit. Museum, I., p. 52.
1846. Encyrtidæ, Family (partim), Walker, List Chalc. Brit. Museum, I., p. 53.
1848. Pteromalidæ, Family V. (partim), Walker, List Chalc. Brit. Museum, II., p. 104.
1856. Eupelmoidæ, Familie IV. (partim), Förster, Hym. Stud., II., pp. 18, 21 and 30.
1856. Encyrtoidæ, Familie V. (partim), Förster, Hym. Stud., II., pp. 18, 21 and 32.
1875. Encyrtina, Subtribus (partim), Thomson, Hym. Skand., IV., pp. 12 and 112.
1885. Encyrtinæ, Subfamily (partim), Howard, Ent. Amer., I., pp. 198, 216.
1897. Encyrtidæ, Family LXVIII., Ashmead, Proc. Ent. Soc. Washington, IV., p. 236.
1900. Encyrtidæ, Family LXVIII., Ashmead, Proc. U. S. Nat. Museum, XXII., p. 202.

This family was very fully characterized and discussed in my paper entitled "On the Genera of the Subfamily Encyrtinæ," published in the Proceedings of the U. S. National Museum for 1900. It is unnecessary, therefore, to repeat the characterization of the group, since the classification here is practically identical, the only change being the establishment of a new tribe in the *Eupelminæ*, and some new genera in the various tribes.

TABLE OF SUBFAMILIES.

1. Mesonotum entire, convex or subconvex, the parapsidal furrows entirely absent 2
Mesonotum not entire, usually depressed or impressed, rarely convex, the parapsidal furrows distinct or at least more or less distinct, never entirely wanting; marginal vein usually long.
Subfamily I. Eupelminæ.

2. Marginal vein rarely very long, often punctiform, and always much shorter than the submarginal or subcostal vein; stigmal vein usually short, rarely long; scutellum never short or transversely linear; middle tibiæ without lateral spurs .... Subfamily II. ENCYRTINÆ.
   Marginal vein long, as long as the submarginal or subcostal vein; scutellum very short, transversely linear; middle tibiæ with lateral spurs, the apical spur lobed....... Subfamily III. SIGNIPHORINÆ.

SUBFAMILY I. EUPELMINÆ.

1846. Eupelmidæ, Family (partim), Walker, Ann. & Mag. Nat. Hist., XVII., p. 114.
1856. Eupelmoidæ, Familie 4, Förster, Hym. Stud., II., pp. 18, 21 and 30.
1875. Eupelmina, Tribus, Thomson, Hym. Skand., IV., pp. 11 and 102.
1886. Eupelminæ, Subfamily, Howard, Ent. Amer., I., p. 198.
1897. Eupelminæ, Subfamily I., Ashmead, Proc. Ent. Soc. Washington, IV., p. 238.

This subfamily is quite distinct from the other two subfamilies, and is easily recognized by the structural peculiarities of the mesonotum brought out in my table of subfamilies.

A full account of the group is given in my paper entitled, "On the Genera of the Eupelminæ," published in the Proceedings of the Entomological Society of Washington for 1896. Since that paper was published, however, a new tribe and some new genera have been recognized; these are characterized below.

TABLE OF TRIBES.

Mesonotum in females always depressed or impressed, concave or subconcave, medially with usually a triangular elevation anteriorly, the parapsidal furrows not, or rarely, sharply defined, never short; in males subconvex, with the furrows rarely complete, not short nor curved off laterally..... Tribe I. Eupelmini.

Mesonotum convex in both sexes, the parapsidal furrows delicate, but always complete, short and strongly curved off laterally, the scapulæ short.......................................Tribe II. Tanaostigmini.

TRIBE I. *Eupelmini.*

The impressed and incomplete mesonotal furrows in the females distinguish the group. The males are not so readily defined, and are easily mistaken for males in the family *Cleonymidæ*, the mesonotum being sometimes subconvex, with the furrows complete or incomplete; the mesopleura are, however, usually *entire* and this peculiarity, together with the venation, the structural characters of the head, the antennæ and the metathorax, will, in most cases, distinguish these insects.

TABLE OF GENERA.

1. Females 2
   Males 37
2. Hind tibiæ and first tarsal joint compressed and broad 3
   Hind tibiæ and first tarsal joint neither compressed nor broad (rarely with the hind tibiæ slightly compressed) 4

3. Eyes hairy ; antennæ 13-jointed ; axillæ meeting at base of scutellum. . . . .**Metapelma** Westwood (type *M. spectabilis* Westw.).

4. Front femora much swollen 5
   Front femora normal, or not much swollen 6

5. Winged ; front femora armed with minute spines beneath ; ovipositor very long . . . . .**Oodera** Westwood (type *O. gracilis* Westw.).
   Wingless ; front femora unarmed ; ovipositor subexserted ; head large, quadrate ; eyes rounded, bare ; temples broad. . . . . **Ooderella** Ashmead (type *O. smithii* Ashm.).

6. First tarsal joint of middle legs *without* strong spines beneath, at most with hairs. 7
   First tarsal joint of middle legs *with* strong spines or minute black teeth beneath. 8

7. Mesonotum not impressed ; axillæ triangular, meeting at base of scutellum. . . . . .**Charitopus** Förster (type *C. fulviventris* Först.).

8. Face deeply excavated, the front ocellus always placed in the furrow 9
   Face rarely deeply excavated, although often with deep antennal furrows, the front ocellus never placed in the furrow 12

9. Middle tibiæ very long 10
   Middle tibiæ not very long 11

10. Antennæ inserted near the border of the mouth. . . . . **Stenoceroides** Dalla Torre = *Stenocera* Walker (type *S. walkeri* Curtis).
    Antennæ inserted far above the mouth border ; postmarginal vein greatly lengthened.
    Polymoria Förster (type *P. coronata* Thomson).

11. Axillæ not united at base of the scutellum, their inner suture strongly curved ; postmarginal vein very short, scarcely developed, or rarely longer than the stigmal vein. . . . .**Eusandalum** Ratzeburg = *Balcha* Walker = *Ratzeburgia* Förster (type *E. abbreviatum* Ratz.).

12. Eyes hairy or pubescent 13
    Eyes bare 14

13. Scutellum with a broad base against the mesonotum, the axillæ being widely separated 26
    Scutellum with a narrow base against the mesonotum, the axillæ approximate or united at base of scutellum 17

14. Hind tibiæ with 2 apical spurs 15
    Hind tibiæ with 1 apical spur 16

15. Antennæ inserted below the middle of the face ; stigmal vein very long, curved. . . .**Calosoter** Walker (type *Pteromalus eneubalus* Walk.).
    Antennæ inserted above the middle of the face ; stigmal vein very short. . . . .**Chirolophus** Haliday (type *C. eques* Haliday).

16. Head large, transverse, wider than the thorax, the eyes large, oblong oval, convergent above, the vertex, however, not especially narrow, the lateral ocelli close to the eyes but not touching the inner margin ; antennæ subclavate, inserted a little below the base of the eyes, and widely separated ; abdomen depressed, not longer than the thorax, the ovipositor hidden. . . . . **Solindenia** Cameron (type *S. picticornis* Cam.).

17. Second dorsal abdominal segment short, not incised at apical margin 18
    Second, third and fourth dorsal abdominal segments usually incised medially at apical margin, the second the largest segment 19

18. Stigmal vein not short ; abdomen oval, narrower than the thorax, ovipositor exserted.
    Brasema Cameron (type *B. brevispina* Cam.).

19. Abdomen at the most with dorsal segments 1 to 3 incised at apical middle; sometimes with only the first and second incised 20
Abdomen with dorsal segments 2 to 5 incised or emarginate at apical margin 25
20. Second abdominal segment not as long as all the segments united 21
Second abdominal segment as long as all the segments united 24
21. Eyes neither especially large nor strongly convergent above (although somewhat convergent), the vertex not very narrow, the hind ocelli not approximate 22
Eyes very large, strongly convergent above, the vertex narrow, the hind ocelli very approximate, the front ocellus placed far anteriorly 23
22. Frons with a deep ʌ-shaped antennal furrow; antennæ 13-jointed, ringed with white, inserted close to the mouth .... **Idoleupelmus** Ashmead (type *I. annulicornis* Ashmead).
Frons deeply grooved; antennæ 13-jointed, but not ringed with white, clavate, obliquely truncate at apex from beneath, inserted on or near the middle of the face; abdomen longer than the head and thorax united, the dorsal segments 1–3 incised at apical middle .... **Macreupelmus** Ashmead (type *M. brasiliensis* Ashmead).
23. Abdomen spatulate; occiput with a bunch of deep black bristles behind the ocelli. **Tineobius** Ashmead (type *T. citri* Ashmead).
Abdomen long, oblong-oval; occiput normal ..... **Ischnopsis** Ashmead (type *I. ophthalmica* Ashmead).
24. Eyes converging above; antennæ inserted on the middle of the face .... **Lutnes** Cameron (type *L. ornaticornis* Cam.).
25. Scape long and more or less compressed; postmarginal vein very long, the stigmal vein curved, not short .... **Cerambycobius** Ashmead (type *Eupelmus cleri* Ashm.).
26. Wingless or subapterous 27
Winged 29
27. Metathoracic angles normal; antennæ inserted only a little below the middle of the face, never close to the mouth border; face without transverse furrows 28
Metathoracic angles spined; antennæ inserted close to the mouth border; face with transverse furrows. **Myrmecomimesis** Dalla Torre (type *Myrmecopsis nigricans* Walk.).
28. Abdomen with dorsal segments 2 to 6 not incised at apical middle .... **Eupelminus** Dalla Torre (type *Urocryptus excavatus* Westw.).
Abdomen with dorsal segments 2 to 6 more or less incised or emarginate at apical middle (apterous forms) .... **Eupelmus** Dalman.
29. Abdomen long, conic-ovate, oblong, or conically acuminate, as long or much longer than the head and thorax united, the dorsal flap always deeply incised at apical middle 30
Abdomen clavate or spatulate, broadened behind, narrowed toward the base, not as long as the thorax or shorter than the head and thorax united, depressed or flat above, the dorsal flaps not incised or the incision is not very deep 33
30. Ovipositor shorter than the body, usually shorter than the abdomen 31
Ovipositor always longer than the entire body, usually very much longer 32
31. Antennæ inserted a little *below* the middle of the face, on or above an imaginary line drawn from the base of the eyes, rarely a little below it .... **Eupelmus** Dalman (type *E. memnomius* Dalm.).
Antennæ inserted above the middle of the face, or at least never below the middle.
Axillæ widely separated at base of scutellum; wings not short, the marginal vein long, the stigmal vein very short, the postmarginal long; antennæ 13-jointed ...... **Charitolophus** Förster (type *C. cœrulescens* Först.).
Axillæ approximate; wings short, somewhat narrowed; antennæ 9-jointed (*teste* Motschulsky). **Cacotropia** Motschulsky (type *C. echidna* Motsch.).

32. Scape compressed, extending far beyond the ocelli; scutellum *without* a tuft of long stiff bristles at apex; abdomen elongate, the dorsal flap and segments 2–4 incised at apical middle; ovipositor very much longer than the entire insect.................. **Phlebopenes** Perty (type *P. splendidus* Perty).

Scape long, slender, cylindrical, extending only a little above the ocelli; scutellum with a tuft of long, stiff black bristles, as in *Encyrtus* Latr.; abdomen not so elongate, segments 2–5 at apex, excised medially; ovipositor a little longer than the entire insect; front wings with a broad fuscous band across the middle.................. **Encyrtaspis** Ashmead, g. nov. (type *E. brasiliensis* Ashm.).

33. Head viewed from in front normal, at least as long as wide, or at least only a little wider than long; antennal furrows not very deep and very short; eyes oblong or ovate........................ 34

Head viewed from in front about twice as wide as long, the antennal furrows very deep; eyes round, strongly convergent above; postmarginal vein not longer than the stigmal. **Lecaniobius** Ashmead (type *L. cockerellii* Ashm.).

34. Scutellum normal, *without* a tuft of hairs.. 35

Scutellum *with* a fascicle of hairs; club of antennæ compressed..................... **Hoplopsis** Destefani (type *H. mayri* Destefani).

35. Malar furrow distinct; no carina from the lower part of each eye to base of each antenna; antennæ inserted on or somewhat below an imaginary line drawn from base of eyes, rarely slightly above this line.................................... **Anastatus** Motschulsky (type *A. mantoidæ* Motsch.).

Malar furrows indistinct or subobsolete; a distinct carina extends from the lower part of each eye to the base of each antenna; antennæ inserted just above the clypeus........ **Arachnophaga** Ashmead (type *Eupelmus piceus* How.).

36. Hind tibiæ and first tarsal joint compressed, broad... 37

Hind tibiæ and first tarsal joint simple, the tibiæ rarely slightly compressed, never broad, the first tarsal joint always cylindrical.. 38

37. Eyes hairy; flagellum subclavate, obliquely truncate at tip................. **Metapelma** Westwood

38. Front femora much swollen.. 39

Front femora normal.. 40

39. Front femora armed with minute spines beneath.................................. **Oodera** Westwood.

Front femora not armed with minute spines beneath.......................... **Ooderella** Ashmead.

40. Antennæ ramose or branched.. 41

Antennæ simple, without branches... 42

41. Flagellum with *four* branches.

Eyes bare....................................... **Chirolophus** Haliday (type *C. eques* Hal.).

Eyes hairy.............................. **Chiritolophus** Förster (type *C. cærulescens* Först.).

42. Antennæ inserted near the middle of the face or *above* an imaginary line drawn from the base of the eyes.. 43

Antennæ inserted just above the clypeus or below an imaginary line drawn from the base of the eyes. 48

43. Mesonotal furrows incomplete or wanting at the most vaguely impressed or indicated only anteriorly and converging and ending near the middle of the scutum.................................. 44

Mesonotal furrows distinct, entire.. 45

44. Axilla united or not widely separate at the base of the scutellum.......................... 46

Axillæ well separated at base of the scutellum.

Stigmal and postmarginal veins short, the latter the shorter, always much abbreviated; hind sutures of axillæ curved; scape not compressed................ **Eusandalum** Ratzeburg.

Stigmal and postmarginal veins not short, the latter a little the longer; hind sutures of axillæ straight; scape somewhat compressed .... **Calosoter** Walker.

45. Hind tibiæ not compressed.. 48
Hind tibiæ compressed.
Pedicel not small, obconical, larger than the first joint of the flagellum. ? genus
46. Eyes pubescent .... **Macreupelmus** Ashmead.
47. Postmarginal vein long, twice or nearly twice as long as the stigmal vein; scape short; flagellum filiform, clothed with a dense pubescence; pedicel minute.
Joints 1–7 of funicle always longer than thick, the club-joints not very long.
Cerambycobius Ashmead.
Joints of funicle very short, thicker than long, the club-joints usually very long.
Anastatus Motschulsky.
48. Hind tibiæ somewhat compressed.
Pedicel obconic, smaller than the first joint of the funicle, the joints of the flagellum, except sometimes 6 and 7, longer than thick; dorsal abdominal segments not incised medially at apex.
Arachnophaga Ashmead.

Tribe II. *Tanaostigmini.*

This little group is allied to the subfamily *Encyrtinæ*, in which group Dr. Howard first placed his genus *Tanaostigma*, and also to the family *Cleonymidæ*, where, deceived by a male specimen, I first placed the genus *Eutrichosoma*. Additional specimens, and the discovery of two new genera have enabled me to see more clearly the affinities and relationship of the group to other chalcidids, and I believe other discoveries will confirm my views in assigning it a position with the *Eupelminæ* rather than with the *Encyrtinæ*.

TABLE OF GENERA.

1. Female 2
Males 5
2. Scape of antennæ slender, not at all dilated 4
Scape of antennæ broadly dilated beneath, or dilated, or compressed its entire length.
Scape compressed or dilated its entire length 3
Scape broadly dilated beneath; flagellum flattened, the joints of the funicle subpedunculate and much wider than long; postmarginal vein shorter than the stigmal, the latter long; postmarginal vein shorter than the stigmal, the latter long, nearly perpendicular with the front margin; abdomen not longer than the thorax, the ovipositor slightly exserted.
Tanaostigma Howard (type *T. coursetiæ* Howard).
3. Flagellum subclavate, the joints of the funicle cylindrical, a little longer than thick; postmarginal vein about as long as the stigmal vein, the latter not short; body bare; abdomen as long as or a little longer than the head and thorax united..............**Tanaostigmodes** Ashmead (type *T. howardii* Ashm.).
Flagellum subcompressed, the funicle joints, or at least 1 to 3, wider than long; body well clothed with short, scale-like white hairs; abdomen subglobose, scarcely as long as the thorax, the ovipositor subexserted........................**Trichencyrtus** Ashmead, gen. nov. (type *T. chapadæ* Ashm.).
4. Body clothed with short scale-like white hairs; scape very slender, the flagellum stout, pubescent, the joints wider than long; wings glabrous, the stigmal vein ending in a knob, slightly curved and as long as the marginal vein, the postmarginal vein wanting......................**Eutrichosoma** Ashmead (type *E. mirabile* Ashm.).

5. Flagellum filiform, *without* branches 6
   Flagellum with four branches.
      Body bare or nearly.
         Branches of flagellum long. . . . . **Tanaostigma** Howard.
         Branches of flagellum short . . . . **Tanaostigmodes** Ashmead.
      Body well clothed with short, stout, scale-like white hairs . . . . **Trichencyrtus** Ashmead.
6. Body well clothed with short, stout, scale-like white hairs; wings glabrous, the stigmal vein curved, as long as the marginal vein and ending in a knob, the postmarginal vein absent; scape very slender, the joints of the funicle much wider than long and briefly but distinctly pedicellate.
   Eutrichosoma Ashmead.

Subfamily II. Encyrtinæ.

1840. Encyrtides, Subfamily 4 (partim), Westwood, Intro. Mod. Class Ins. Synop., p. 72.

1856. Encyrtoidæ, Familie 5, Förster, Hym. Stud., I., p. 18.

1875. Encyrtina, Tribus, Thomson, Hym. Skand., IV., pp. 12 and 112.

1886. Encyrtinæ, Subfamily, Howard, Ent. Amer., I., p. 198.

1897. Encyrtinæ, Subfamily II., Ashmead, Proc. Ent. Soc. Washington, IV., p. 248.

1900. Encyrtinæ, Subfamily II., Ashmead, Proc. U. S. Nat. Mus., XXIII., p. 324.

This subfamily was fully characterized in my paper, "On the Genera of the Encyrtinæ," published in 1900.

The four tribes into which it was divided may be recognized by the aid of the following table:

TABLE OF TRIBES.

1. Mandibles bi- or *tri*-dentate, or broadly truncate at apex, never acute; tarsi always 5-jointed 2
   Mandibles dentate, acute at apex 5
2. Mandibles at apex, bidentate or, truncate 3
   Mandibles at apex tridentate, the teeth sometimes very minute; labrum usually conspicuous. 4
3. Mandibles not stout, or only moderately so, rather long and always bidentate at apex; labrum free; abdomen in females with the hypopygium large, lanceolate or plowshare-shaped, inclosing the ovipositor, and extending beyond the anus; the second segment most frequently large; antennæ usually inserted just above the clypeus, rarely just below the middle of the face. Tribe I. Ectromini.
   Mandibles stout, but short and polished, the apex broadly truncate, unarmed or nearly so; labrum conspicuous; abdomen with the hypopygium less evidently prominent, not projecting; body usually stout, not metallic; hind tibiæ with *two* spurs; antennæ inserted below the middle of the face.
   Tribe II. Encyrtinæ.
4. Hind tibiæ with *one* apical spur; hypopygium not prominent; body most frequently, but not always metallic; antennæ variable . . . . Tribe III. Mirini.
5. Tarsi 4- or 5-jointed; marginal vein punctiform, or subobsolete. . . . . Tribe IV. Arrhenophagini.

Tribe I. *Ectromini.*

In this tribe the species are usually more elongate and narrower, the marginal vein proportionately longer, with the stigmal vein shorter, while the mandibles are

always narrower and bidentate. In the females the hypopygium is usually prominent.

TABLE OF GENERA.

1. Females 2
   Males 24
2. Face with a distinct carina between the base of the antennæ........ 15
   Face without such a carina, rarely with a rounded ridge; antennæ inserted just above the clypeus, or below the middle of the face.
   Wingless or subapterous species 11
   Winged species........ 3
3. Front wings with the marginal vein rather long, twice as long as the stigmal vein, or even longer, always much longer than the stigmal........ 4
   Front wings with the marginal vein short, the postmarginal vein very short........ 10
4. Stigmal and postmarginal veins not short, or rarely short, the postmarginal vein most frequently longer than the stigmal 5
   Stigmal and postmarginal veins short; scape slender, cylindrical.
   Wings fuscous, marked with white bands or rays; frons broad, the lateral ocelli nearer to the eye margin than to the front ocellus. **Calocerinus** Howard (type *Tetracnemus floridanus* Ashm.).
   Wings hyaline; frons not so broad, the lateral ocelli not nearer to the eye margin than to the front ocellus........**Tetralophidia** Ashmead (type *T. bakeri* Ashm.).
5. Funicle 6-jointed, without ring-joints........ 6
   Funicle 4-jointed, with *two* ring-joints.
   Frons minutely shagreened, with minute punctures scattered over the surface; scape slender, cylindrical, the flagellum at the most subclavate; stigmal vein very oblique, subclavate.
   Meromyzobia Ashmead (type *Ericydnus maculipennis* Ashm.).
6. Stigmal and postmarginal veins short, the latter sometimes hardly developed; front wings with a discoidal blotch........ 7
   Stigmal and postmarginal veins not short, usually long, the latter the longer, sometimes as long as the marginal; front wings without a discoidal blotch........ 8
7. Frons very minutely shagreened, with minute punctures scattered over the surface, or almost smooth.
   Head viewed from in front longer than wide; scutellum *with* a tuft of long hairs; abdomen scarcely longer than the head and thorax united, the ovipositor not or scarcely exserted; flagellum gradually broadened towards apex, compressed, the pedicel hardly as long as the first joint of the funicle; the joints after the third broader than long.
   Chrysopophagus Ashmead (type *C. compressicornis* Ashm.).
   Head viewed from in front not longer than wide, if anything a little wider than long; scutellum *without* a tuft of long hairs; abdomen distinctly longer than the head and thorax united, with a prominent ovipositor which is longer than half the length of the abdomen; flagellum subclavate, not compressed, the funicle joints longer than thick.......**Tineophoctonus** Ashmead (type *Phænodescus armatus* Ashm.).
8. Frons regularly punctate, or broad and smooth, margaritaceously shining........ 9
   Frons minutely shagreened, with minute punctures scattered over the surface; scape not compressedly dilated beneath, either cylindrical or subcylindrical.
   Antennæ not longer than the body, usually somewhat shorter, the first joint of the flagellum rarely more than twice as long as thick; stigmal vein not curved; axillæ just meet at inner basal angles........**Ericydnus** Walker (type *Encyrtus longicornis* Dalm.).

Antennæ longer than the body, the first joint of the flagellum about five times as long as thick; stigmal vein gently curved; axillæ unite and form a slight ridge at base of scutellum.
Leptomastix Förster (type *L. histrio* Mayr).

9. Frons regularly punctate; scape beneath broadly compressedly dilated, the flagellum long, filiform, cylindrical; scutellum triangular, acute at apex, the axillæ separated.......... **Dinocarsis** Förster (type *Encyrtus hemipterus* Dalm.).

Frons broad and smooth, margaritaceously shining, or at the most feebly shagreened; scape long, slender, the flagellum long, subcylindrical, feebly compressed, the first joint the longest, somewhat more than twice as long as thick; scutellum bifoveate at base. .... **Ectroma** Westwood (type *Eupelmus rufus* Dalm.).

10. Frons finely shagreened or alutaceous, subopaque; lateral ocelli close to the eye margin; scape usually broadly compressedly dilated beneath, the flagellum *slender, cylindrical;* axillæ not quite meeting at inner basal angles; front wings with a hairless line extending obliquely inward from the stigmal vein....................................... **Anagyrus** Howard (type *A. greenii* How.).

Frons narrow, almost smooth; lateral ocelli close to the eye margin; scape broadly dilated beneath, the flagellum *compressed, fusiform,* as seen from the side; axillæ meet at inner basal angle.
Anusia Förster (type *Ectroma fulvescens* Westw.).

11. Frons regularly punctate, coriaceous or shagreened, with distinct scattered punctures over the surface 12

Frons smooth, margaritaceously shining, or at the most microscopically shagreened.............. 13

12. Scutellum triangular, acute at apex; scape dilated and compressed beneath...... **Dinocarsis** Förster.

Scutellum subtriangular, rounded, not acute at apex; scape slender, cylindrical or at most subclavate.

Flagellum filiform or subclavate, *not* compressed; axillæ touching each other at base of scutellum.

Funicle 4-jointed, with 2 ring-joints; ocelli normal, the lateral close to the eye margin, but not touching it...................................... **Meromyzobia** Ashmead.

Funicle 6-jointed, with no ring-joint; ocelli very minute, the lateral lying close to the eye margin.. **Ericydnus** Walker.

Flagellum compressed; axillæ separated, not touching each other at base of scutellum; lateral ocelli not close to the eye margin; ovipositor exserted, the hypopygium very prominent.
Henicopygus Ashmead (type *H. subapterus* Ashm.).

13. Scutellum subtriangular; head transverse.

Scutellum without foveæ 14

Scutellum bifoveate at base.

Scape and flagellum not at all compressed, cylindrical........... **Ectroma** Westwood.

14. Scutellum normal; scape broadly dilated beneath, the flagellum compressed, fusiform.
Anusia Förster.

Scutellum lunate; head seen from above subquadrate, wider than the thorax, the lateral ocelli rather close to the eye margin; thorax with a silvery pubescence....................... **Bæocharis** Mayr (type *B. pascuorum* Mayr).

15. Frons not broad.. 16

Frons broad, sublenticular, the occipital margin acute.

Front wings with the postmarginal and stigmal veins rather long, equal, not or scarcely shorter than the marginal; clypeus excised at apex; antennæ long, filiform, somewhat distant at base, the pedicel shorter than the first joint of the funicle.......... **Stenoterys** Thomson (type *S. orbitalis* Thoms.).

Front wings with the marginal and postmarginal veins very short, the latter scarcely developed, the marginal vein almost punctiform; clypeus normal; antennæ long, cylindrical, subclavate, the scape slender, the pedicel twice as long as the first joint of funicle.

Tetracnemoidea Howard (type *T. australiensis* How.).

16. Axillæ united at the inner basal angles, or at least touching each other 17

Axillæ widely separated at inner basal angles; postmarginal vein not developed.

Eyes rounded; antennæ inserted far anteriorly below an imaginary line drawn from the base of the eyes .... **Tetracnemus** Westwood (type *T. diversicornis* Westw.).

17. Eyes bare, not pubescent 18

Eyes pubescent.

Marginal vein a little shorter than the stigmal vein, the postmarginal vein at least as long as the stigmal vein; flagellum clavate; the funicle joints short, wider than long.

Habrolepoidea Howard (type *H. glauca* How.).

18. Wings hyaline 19

Wings fuscous, with white rays or bands 23

19. Marginal vein punctiform, not longer than thick, the postmarginal vein *not* developed 22

Marginal vein not punctiform.

Marginal vein always longer than the stigmal vein 20

Marginal vein always shorter than the stigmal vein 21

20. Marginal vein about thrice as long as the stigmal vein, the postmarginal vein not longer than the shaft of the stigmal vein, the latter short, perpendicular; axillæ just meet at their inner basal angles; pronotum very short, scarcely visible from above; mesonotum scaly punctate, or reticulate.

Tetralophiellus Ashmead (type *T. brevicollis* Ashm.).

Marginal vein only a little longer than the stigmal vein, the postmarginal vein very short, hardly developed; axillæ meet at inner basal angles; pronotum not short, conical; mesonotum smooth; antennæ not short, subclavate .... **Tetracladia** Howard (type *T. texana* How.).

21. Marginal vein fully twice as long as thick or about half the length of the stigmal vein, the postmarginal vein only slightly developed; antennæ clavate, the club ovate, 3-jointed, much stouter than the funicle, the scape more than twice as long as thick at apex; funicle joints one fourth longer than thick; pronotum very short, transverse linear; mesonotum microscopically reticulate; hypopygium very prominent, plowshare-shaped .... **Tetracnemopsis** Ashmead (type *Tetracnemus westwoodii* Ckll.).

22. Antennæ subclavate, the pedicel hardly longer than thick at apex, but longer than the first joint of the funicle; funicle joints submoniliform; pronotum very short; mesonotum shagreened or scaly punctate .... **Pentacnemus** Howard (type *P. bucculatricis* How.).

23. Marginal vein about twice as long as thick, not longer than the stigmal, the postmarginal vein hardly so long; axillæ not quite meeting an inner basal angles; antennæ subclavate, inserted close to the mouth, the scape long, slender, only slightly thickened towards apex; funicle joints 1–2 subequal, hardly longer than thick, the following gradually increasing in thickness; eyes very large; frons narrow; mesonotum smooth, metallic, a little shorter than the scutellum, the latter opaque, shagreened; abdomen ovate, shorter than the thorax, depressed .... **Habrolepopteryx** Ashmead (type *Psilophrys pulchripennis* Ashm.).

24. Epistoma *not* carinate 25

Epistoma carinate 39

25. Antennæ ramose, *with* 4 branches 26

Antennæ simple, *without* branches, the scape and flagellum sometimes dilated or compressed 27

26. Marginal vein rather long, the stigmal and postmarginal veins short.
Wings with fuscous rays; lataral ocelli nearer to the eye margin than to the front ocellus; axillæ meeting at base of scutellum .... **Calocerinus** Howard.
Wings hyaline; lateral ocelli not nearer to the eye margin than to the front ocellus; axillæ not quite meeting at base of the scutellum .... **Tetralophidea** Ashmead.
27. Winged forms 28
Wingless or subapterous forms 36
28. Front wings with the marginal vein linear, longer than the stigmal, the postmarginal vein rather short, hardly so long as the stigmal or clearly shorter, the stigmal vein bent so as to be nearly parallel with it 28
Front wings with the marginal vein usually shorter, the stigmal and postmarginal veins short, or the stigmal vein is longer than the marginal and postmarginal veins united, or if with the marginal vein long or somewhat long, the stigmal and postmarginal veins are not short, the stigmal vein not bent so as to be nearly parallel with the marginal 29
28. Frons and scutellum finely coriaceous, the thorax metallic or submetallic, with silvery hairs; flagellum filiform, the joints subequal, at least three times as long as thick, with long, sparse hairs.
Chrysopophagus Ashmead.
29. Marginal vein long or somewhat long, the stigmal and postmarginal veins not short 30
Marginal vein usually shorter, the stigmal and postmarginal veins short, or the stigmal vein longer than the short marginal and postmarginal veins united 34
30. Frons minutely shagreened, with some minute punctures scattered over the surface 31
Frons broad, smooth, margaritaceously shining, impunctate 33
31. Antennæ 11-jointed, with a 6-jointed funicle 32
Antennæ 9-jointed, with a 4-jointed funicle .... **Meromyzobia** Ashmead.
32. Antennæ not longer than the body, the joints of the flagellum closely united and clothed with a short, dense pubescence .... **Ericydnus** Walker.
Antennæ much longer than the body, the joints of the flagellum subpedunculate and each joint furnished with two whorls of long hairs .... **Leptomastix** Förster.
33. Antennæ long, filiform, 9-jointed, feebly compressed .... **Ectroma** Westwood.
34. Marginal vein slender, not stout 35
Marginal vein rather short and stout, the stigmal and postmarginal veins very short.
Scape usually broadly dilated below, the flagellum slender, cylindrical ..... **Anagyrus** Howard.
35. Stigmal vein long; scape long, dilated and compressed beneath, the flagellum filiform, clothed with a short dense pile; scutellum triangular, acute at apex; body shagreened .... **Dinocarsis** Förster.
Stigmal vein short; scape broadly compressedly dilated beneath, the flagellum compressed, fusiform, broadest towards the middle and gradually tapering off towards apex .... **Anusia** Förster.
36. Scutellum lunate 38
Scutellum triangular or subtriangular, never lunate.
Frons smooth, shining, somewhat iridescent 37
Frons shagreened or feebly punctate.
Scape and flagellum normal, the latter clothed with a short, dense pile.
Ericydnus Walker.
37. Scutellum bifoveate at base; scape and flagellum not at all compressed, cylindrical.
Ectroma Westwood.
Scutellum not foveate at base; scape broadly dilated beneath, the flagellum compressed, fusiform.
Anusia Förster.

38. Frons convex, finely coriaceous; scape rather short, clavate, the pedicel twice as long as thick at tip, longer than the first funicle joint .... **Bæocharis** Mayr.

39. Frons not broad 40

Frons broad; axillæ united at inner basal angles.

Antennæ long, fusiform, *without* branches, and inserted rather high up on the face, the flagellum clothed with sparse black pile .... **Stenoterys** Thomson.

Antennæ *with* 4 branches, a branch on joints 1 to 4 of funicle .... **Tetracnemoidea** Ashmead.

40. Axillæ united or touching each other at their inner basal angles; antennæ either simple or ramose 41

Axillæ either widely separated or at least not touching each other at their inner basal angles.

Antennæ with 4 branches .... **Tetracnemus** Westwood.

41. Eyes bare, *not* pubescent 42

Eyes pubescent.

Marginal vein a little shorter than the stigmal, the postmarginal vein at least as long as the stigmal vein, flagellum hairy, *without* branches .... **Habrolepoidea** Howard.

42. Antennæ with *five* long branches 44

Antennæ with *four* long branches.

Marginal vein not thrice as long as the stigmal vein; *postmarginal vein very short or not developed* 43

Marginal vein about thrice as long as the stigmal vein, the postmarginal vein short; pronotum very short .... **Tetralophiella** Ashmead.

43. Marginal vein only a little longer than the stigmal; pronotum not short, conical, at least as long as the mesonotum .... **Tetracladia** Howard.

Marginal vein only about thrice as long as thick or about half the length of the stigmal; pronotum *very* short .... **Tetracnemopsis** Ashmead.

44. Marginal vein punctiform, not half the length of the stigmal, the postmarginal wanting. **Pentacnemus** Howard.

TRIBE II. *Encyrtini.*

The species falling in this tribe are broad and robust, the mandibles being broad and stout, truncate at apex, and edentate or nearly; the labrum is conspicuous; the antennæ are very similar in both sexes; the marginal vein in the front wings is short, the stigmal and postmarginal veins being usually long; in the hind wings the marginal cell is long and broad, while the hind tibiæ have *two* apical spurs.

TABLE OF GENERA.

1. Metathorax with the lateral ridge bare; spurs of hind tibiæ nearly equal 2

Metathorax with the lateral ridge or at least the metapleura clothed with a silvery white pubescence; spurs of the hind tibiæ unequal 3

2. Frons broad with a sparse, thimble-like punctuation, thicker towards the scrobes; stigmal and postmarginal veins long, nearly equal in length and three or more times longer than the marginal; apical half or more of front wings usually infumated; scape long and slender.

Scutellum *with* a tuft of long hairs towards apex; first joint of the flagellum hardly so long as the second .... **Encyrtus** Latreille (type *Chrysis infidus* Rossi).

Scutellum *without* a tuft of long hairs; first joint of the flagellum a little longer than the second. **Howardiella** Dalla Torre (type *Bothriothorax peckhami* Ashm.).

3. Frons not broad, nearly smooth, opaque or minutely shagreened, or with only a few minute punctures; stigmal and postmarginal veins unequal, the latter only slightly developed, the marginal vein very short, nearly punctiform; front wings hyaline but with a discoidal cloud.........**Prionomastix** Mayr (type *Encyrtus morio* Dalman).

Tribe III. *Mirini.*

In this tribe fall the vast majority of the genera of the subfamily *Encyrtinæ*, distinguished from the others by the mandibles, which are somewhat differently shaped, and *tridentate* at apex. The tribe was fully discussed in the Proceedings of the U. S. National Museum for 1900. The table of the genera published below is practically the same as published in that work, except that some slight changes have been made to enable me to incorporate some interesting new genera unknown at that time.

TABLE OF GENERA.

1. Females.. 2
   Males.. 58
2. Mandibles rather long, with acute teeth, the apical tooth usually the longest, rarely with the two apical teeth longer than the inner; labrum conspicuous; front very closely punctate, or finely coriaceous, the thimble-like punctures absent, or the punctures smaller or more sparsely scattered; wings not ornate, and usually with a very short, or a punctiform, marginal vein, the hind wings usually with a long costal cell that extends to the hooklets; abdomen usually more or less compressed towards apex, the ventral valve extending to the anus but not plowshare-shaped; head as viewed from in front usually somewhat longer than wide, often much longer than wide, or subtriangular, the scrobes forming a triangle.. 3
   Mandibles shorter, with the teeth smaller, less acute and equal or nearly; labrum not conspicuous; frons frequently but not always with a series of large, thimble-like punctures; wings variable, frequently ornate or dusky, although often hyaline; scrobes usually semicircular................. 13
3. Marginal vein punctiform, not or scarcely longer than thick (very rarely twice as long as thick), the postmarginal vein not at all or only slightly developed, very rarely as long as the stigmal vein; stigmal vein is rather long, always more than twice the length of the marginal, or much longer; body metallic or lustrous.. 4
   Marginal vein *not* punctiform, at least twice as long as thick, but usually much longer, the postmarginal vein longer than the stigmal vein.. 12
4. Head viewed from in front long, subtriangular, much longer than wide, the cheeks, or malar space, long.. 5
   Head viewed from in front not or scarcely longer than wide, the cheeks, or malar space, not especially long.. 11
5. Front wings *with* a marginal fringe.. 6
   Front wings *without* a marginal fringe.
      Antennæ very long and slender, the flagellar joints all very long, cylindical, the sixth being at least four times as long as thick, the preceding still longer.................**Psilophrys** Mayr (type *Encyrtus longicornis* Walk.).
6. Pedicel fully three times or more longer than thick at apex.. 7
   Pedicel *not* three times as long as thick at apex.. 10

7. Flagellum very long, two or more times longer than the scape, the funicle joints all cylindrical..... 8
Flagellum not so long, at the most not more than one and a half times the length of the scape, the funicle joints gradually decreasing in length, not all the joints longer than thick, some at least wider than long.. 9
8. Antennæ very long and slender, as in *Psilophrys*, the scape very long and slender; cheeks not quite the length of the eyes; ovipositor very long......**Parapsilophrys** Howard (type *P. gelechiæ* How.).
Antennæ long and slender but shorter than in *Psilophrys*, about twice as long as the scape, the joints of the funicle long and cylindrical, the club not or only a little thicker than the last joint of the funicle; cheeks long..........................**Liothorax** Mayr (type *Encyrtus glaphyra* Walker).
9. Flagellum at the most about one and a half times the length of the scape, the funicle joints gradually decreasing in length, some toward the apex transversely; club much thickened; obliquely truncate from beneath; head and mesonotum finely, closely punctate or shagreened; frons somewhat narrowed; eyes bare........................**Litomastix** Thomson (type *Encyrtus chalconotus* Dalm.).
Flagellum short, not much longer than the scape; the funicle joints, except the first, not longer than thick; club stout, broader than the funicle; frons broad; eyes faintly hairy. **Berecyntus** Howard (type *B. bakeri* Howard).
10. Cheeks as long as the eyes or nearly; antennæ rather long, the funicle joints, however, rarely more than twice as long as thick, gradually thickening apically; the sixth joint never much longer than wide and sometimes wider than long...........**Copidosoma** Ratzeburg (type *C. boucheanus* Ratz.).
11. Cheeks more than half the length of the eyes; pedicel hardly twice as long as thick; the flagellum not long; the joints of the funicle, except the first, small, not longer than thick, submoniliform, but gradually increasing in size...................**Prionomitus** Mayr (type *Encyrtus mitratus* Dalm.).
Cheeks very short, nearly obsolete; pedicel three times as long as thick, the flagellum short, clavate, the joints of the funicle annular, wider than long, the club greatly enlarged, longer than the funicle; mesonotum short, twice as wide as long, the pronotum not visible from above; frons very narrow, the lateral ocelli close to the eye margin; eyes large, rounded, pubescent. **Archinus** Howard (type *A. occupatus* How.).
12. Mesonotum smooth, impunctate, blue or metallic; pedicel about thrice as long as thick, the flagellum long, the joints of the funicle much longer than thick, the club somewhat stouter than the funicle; eyes pubescent; scutellum, but not the axillæ, shagreened................**Parencyrtus** Ashmead. (type *P. brasiliensis* Ashmead).
Mesonotum feebly, sparsely punctate, metallic blue or blue-green; pedicel hardly twice as long as thick, the flagellum long and slender, joints 4–5 twice longer than thick, cylindrical, the club 3-jointed, not thicker than the funicle; eyes large, glabrous; scutellum, as well as the axillæ, sculptured..............................**Cerchysius** Westwood (type *Encyrtus subplanus* Dalm.).
13. Abdomen globose, or subovate, much shorter than the thorax, compressed, clothed with a rigid white pubescence, the second segment usually large, smooth medially; species sometimes apterous. 14
Abdomen with the dorsum flat or concave, not rigidly pubescent................................ 16
14. Pronotum not large; antennæ simple, the flagellum usually long, subclavate, but not broad nor compressed.. 15
Pronotum large, conical, longer than the mesonotum; antennæ with the scape and the flagellum broad, strongly compressed; abdomen globose..... **Mira** Schellenberg (type *M. macrocera* Schell.).
15. Head above rounded, seen from in front much longer than wide; frons narrow; scape long and slender; scutellum not longer than the mesonotum, coriaceous; abdomen ovate, as long as the thorax. **Sphæropisthus** Thomson (type *S. pascuorum* Thomson).

Head seen from in front not longer than wide; frons broad; antennæ not long, inserted on a line with the base of the eyes, flagellum subclavate, the funicle joints, or at least joints 3–6, wider than long; scutellum large, longer than the mesonotum; front wings with a substigmal cloud; postmarginal and stigmal veins long, the latter nearly parallel with the costal margin; abdomen shorter than the thorax, compressed........................**Chestomorpha** Ashmead (type *C. biformis* Ashmead).

16. Head always distinctly lenticular, the scrobes short, the punctures frequently large, thimble-like; hind wings with the costal cell usually extending to the hooklets.................................. 17

Head not or less distinctly lenticular, smooth, shagreened, or finely closely punctate, rarely with a few large punctures scattered over the surface; if with large, coarse, thimble-like punctures, the antennæ are inserted on the middle of the face.. 25

17. Marginal vein short or punctiform, *not* or scarcely longer than thick; mesonotum punctate........ 18

Marginal vein at least twice as long as thick, but usually much longer; mesonotum smooth, impunctate or finely rugulose.. 23

18. Mesonotum with the punctuation similar to that of the head.................................. 19

Mesonotum with the punctuation unlike that of the head, the punctures less dense and the surface coriaceous.. 21

19 Scape normal, not dilated beneath, never with a leaf-like expansion, at the most clavate.......... 20

Scape strongly dilated beneath, or with a leaf-like expansion, the club much enlarged; as long as or longer than the funicle..............................**Ænasius** Walker (type *Æ. hyettus* Walk.).

20. Punctures on the head and thorax coarse and dense.

Mesonotum very short, only half the length of the scutellum; club of antennæ as long as all the funicle joints united; postmarginal vein as long as the stigmal vein...... **Chalcaspis** Howard (type *C. pergandei* How.).

Mesonotum at least as long as the scutellum; club of antennæ shorter than the funicle; postmarginal vein much shorter than the stigmal......................**Bothriothorax** Ratzeburg (type *Encyrtus clavicornis* Dalm.).

Punctures on the head and the thorax smaller and less dense; mesonotum a little longer than the scutellum; funicle joints longer than thick.............**Aratus** Howard (type *A. scutellatus* How.).

21. Vertex very narrow or at least not very broad, and sparsely or very feebly punctate, never closely punctate.. 22

Vertex very broad, with a distinct thimble-like punctuation.

Club of the antennæ shorter than the funicle; postmarginal and stigmal veins short, subequal. **Pentelicus** Howard (type *P. aldrichii* How.).

Club of the antennæ very large, longer than the funicle and the pedicel united; postmarginal and the stigmal veins very long, the latter the shorter...................**Blepyrus** Howard (type *B. mexicanus* How.).

22. Vertex not very narrow, very sparsely and feebly punctate; eyes not especially large, nor nearly occupying the whole sides of the head; scrobes rather deep; scape slightly dilated beneath towards apex, the flagellum subclavate, ringed with white, the club scarcely thicker than the funicle; ocelli in an obtuse triangle, the lateral farther apart than to the front ocellus; wings hyaline, subfuliginous toward base, the marginal vein punctiform, the stigmal vein longer than the short postmarginal and the marginal united...........**Hemænasius** Ashmead (type *H. confusus* Ashm.).

Vertex and face very narrow, feebly punctate; eyes very large, occupying nearly the whole sides of the head and almost meeting on the vertex; front ocellus placed far in advance of the lateral ocelli, the latter close upon the eye margin; flagellum short, clavate, the pedicel large, obconic; first joint

of funicle, as well as the following, transverse; front wings with a large discal cloud beneath the stigmal and marginal veins, the postmarginal and the stigmal veins very long.

Euryrhopalus Howard (type *E. schwarzi* Howard).

23. Marginal vein short, rarely much more than twice longer than thick.......................... 24
Marginal vein rather long, rarely shorter than the stigmal vein.............................. 25

24. Head with some sparse thimble-like or umbilicate punctures; scutellum a little longer than the mesonotum; eyes pubescent.
Club of antennæ not longer than joints 1 and 2 of funicle united, the funicle joints all longer than wide; marginal vein scarcely as long as the stigmal vein, the postmarginal vein longer than the stigmal; abdomen conic-ovate, a little longer than the head and thorax united, with the ovipositor subexserted, dorsum subconcave; mandibles with the two outer teeth longer and more acute than the inner............**Hemencyrtus** Ashmead (type *H. herbertii* Ashm.).
Club of antennæ very large and distinctly longer than the funicle, the funicle joints all very short, wider than long; abdomen depressed, oval, shorter than the thorax; mandibles with small, subequal teeth..................**Coccophoctonus** Ashmead (type *C. dactylopii* Ashm.).

25. Wings embrowned, the costal cell in hind wings narrow and short; mesonotum scarcely as long as the scutellum, finely shagreened, with sparse punctures; eyes large, bare; flagellum ringed with white; pedicel obconical, only a little longer than thick, the following joints gradually shortening, the last three funicle joints being not longer than wide...**Phænodiscus** Förster (type *Encyrtus æneus* Dalm.).
Wings hyaline, the costal cell in hind wings long and narrow; mesonotum scarcely as long as the scutellum, finely transversely rugulose or shagreened, especially anteriorly; eyes pubescent; flagellum subclavate, not ringed with white; pedicel very long, three times as long as thick, the funicle joints, except the first, wider than long.........**Rhytidothorax** Ashmead (type *R. marlatti* Ashm.).

26. Antennæ inserted on or a little above the middle of the face................................... 27
Antennæ inserted near the mouth border or very far below the middle of the face................ 28

27. Frons convex, somewhat coarsely and closely punctate; scape not extending beyond the ocelli; mesothorax rather coarsely shagreened; front wings with the marginal, stigmal and postmarginal veins long, subequal................................**Tanaoneura** Howard (type *T. ashmeadii* Howard).
Frons highly convex but smooth; scape very long, extending far beyond the ocelli; mesonotum smooth, polished; front wings fasciate or maculate, the marginal vein short, the postmarginal and stigmal veins much longer.........................**Hexacladia** Ashmead (type *H. smithii* Howard).

28. Antennæ with the funicle 6-jointed... 29
Antennæ with the funicle 3, 4- or 5-jointed.. 58

29. Metathorax with the pleura and the lateral ridges always clothed with a dense, silvery-white pubescence; body rather robust.. 30
Metathorax bare, or with the lateral ridges superiorly alone pilose........................... 34

30. Antennæ similar in both sexes, the club strongly obliquely acuminate, conical, often white; front wings most frequently with a fuscous cloud or maculate; scape cylindrical, not at all dilated 31
Antennæ dissimilar in the sexes, the club not thicker than the funicle; marginal and postmarginal veins not very short, the former usually, but not always, a little the longer..................... 32

31. Marginal vein not punctiform, the stigmal and postmarginal veins rather long, at least twice longer than the marginal.............................**Homalotylus** Mayr (type *Encyrtus flaminius* Dalm.).
Marginal vein punctiform or nearly; the stigmal vein very long, curved; the postmarginal vein entirely wanting....................................**Isodromus** Howard (type *I. iceryæ* Howard).

32. Thorax *without* a white lunula before the tegulæ; ovipositor not exserted, or if exserted very slender 33

Thorax *with* a white lunula before the tegulæ, rarely without; ovipositor strongly exserted, thick and compressed, the sheaths broad; abdomen rather long, as seen from above conic-ovate.
Cerchysius Westwood (type *Encyrtus subplanus* Dalm.).

33. Frons rather narrow, the eyes large, converging above, the lateral ocelli lying close to the eye margin; abdomen oval or ovate, the ovipositor not exserted; thorax not closely or deeply punctate; hind wings with the costal cell short and narrow....... **Sceptrophorus** Förster (type *S. sceptriger* Först.).

Frons not narrow, the eyes smaller and only slightly converging above, the lateral ocelli not close to the eye border, distant; scrobes semicircular; abdomen oval-rotund, the ovipositor exserted but very slender; thorax short, closely punctate, or with large, deep punctures; hind wings with the costal cell broad and extending to the hooklets............................ **Echthroplexis** Förster (type *Cænocercus puncticollis* Thoms.).

34. Head as viewed from the side with the frons *not* prominent; antennæ normal or at the most with only the scape compressed or dilated; wings hyaline, rarely fuscous or subfuscous with whitish transverse or hyaline bands, the marginal vein rarely punctiform, but rarely longer than the stigmal vein, the postmarginal vein most frequently developed, rarely wanting or shorter than the marginal or stigmal veins.. 34

Head as viewed from the side with the frons prominent, the face inflexed; antennæ frequently strongly compressed, dilated; front wings usually fuscous or with fuscous rays, the marginal vein somewhat thick, oblong, very rarely much shorter or much longer than the stigmal vein, the post-marginal vein usually wanting; ovipositor not or scarcely exserted............................ 48

35. Marginal vein very short, punctiform, rarely longer than thick, the stigmal vein from two and one-half to three times longer than the marginal, the postmarginal vein wanting or short, only slightly developed, rarely well developed; scape slender, or at most subclavate; body metallic............. 36

Marginal vein *not* short, punctiform, although rarely longer than the stigmal vein, the postmarginal vein most frequently well developed, rarely somewhat shorter than the marginal or stigmal veins 38

36. Pedicel obconical, much stouter and longer than the first joint of the funicle, sometimes as long as joints 1 and 2 united; frons rather narrow, the eyes as seen from in front somewhat convergent above; club of antennæ not especially large, shorter than the funicle........................... 37

Pedicel short, scarcely longer than thick; frons moderate, the ocelli about their width from the eye margin; club of antennæ large, the length of the funicle or nearly; funicle joints short, submoniliform, the three or four terminal joints wider than long.................. **Coccidencyrtus** Ashmead (type *Encyrtus ensiger* How.).

37. Lateral ocelli close to or touching the eye margin; postmarginal vein not or only slightly devel oped.

Eyes bare; postmarginal vein not developed........................... **Ooencyrtus** Ashmead (type *Encyrtus clisiocampæ* Ashm.).

Eyes pubescent; postmarginal vein as long as the marginal........ **Ageniaspis** Dahlbom (part).

Lateral ocelli not close to the eye margin, from one and a half to twice their width from it; post-marginal vein somewhat developed...... **Psyllæphagus** Ashmead (type *Encyrtus pachypsydæ* How.).

38. Species *not* metallic; head and thorax opaque or subopaque, alutaceous, or closely microscopically punctate, or shagreened and punctate.. 39

Species metallic or submetallic.. 40

39. Postmarginal vein present.

First joint of the funicle shorter than the pedicel, all the funicle joints being short; marginal vein punctiform................................ **Aphycus** Mayr (type *Encyrtus apicalis* Mayr).

First joint of the funicle much longer than the pedicel, cylindrical, the following gradually shortening, but the last is still a little longer than thick........... **Heterarthrellus** Howard (type *H. australiensis* How.).

Postmarginal vein wanting; joints increase in width, but they are not longer than wide. **Astymachus** Howard (type *A. japonica* How.).

40. Thorax *without* a scaly pubescence, and without white lunulæ before the tegulæ.................... 41

Thorax *with* a scaly pubescence, and *with* white lunulæ before the tegulæ.

Scape more or less dilated beneath, especially towards the apex, rarely simple, the flagellum ringed with white; wings hyaline, the stigmal and postmarginal veins subequal, longer than the marginal.............................. **Blastothrix** Mayr (type *Encyrtus sericeus* Dalm.).

41. Scape normal, not expanded or dilated beneath, at the most subclavate; wings hyaline.......... 42

Scape dilated or expanded beneath, the club not especially enlarged, shorter than the funicle, the latter usually ringed with white, the first four joints of same longer than wide; front wings usually with fuscous bands, or fuscous with hyaline bands or markings............. **Microterys** Thomson (type *Encyrtus sylvius* Dalm.).

42. Thorax finely coriaceous, subopaque, *without* punctures scattered over the surface; frons punctate; postmarginal vein longer than the stigmal.. 43

Thorax smooth, impunctate, or at the most microscopically reticulate, or with fine longitudinal striæ on the mesonotum.. 44

43. Scape subclavate, the funicle 6-jointed, the joints wider than long, the club not thicker than the funicle; front wings hyaline with an oblique hairless line from the marginal vein; stigmal and postmarginal veins longer than the marginal; scutellum with a delicate median grooved line at base. **Holcencyrtus** Ashmead (type *Aphycus niger* Ashmead.).

44. Mesonotum smooth, impunctate, or at the most microscopically reticulate...................... 45

Mesonotum with fine longitudinal striæ.

Stigmal vein scarcely longer than the marginal, the postmarginal longer than the marginal and the stigmal veins united; eyes pubescent; funicle joints 2–4 not longer than thick. **Ageniaspis** Dahlbom (type *Encyrtus fuscicollis* Dalm.).

45. Stigmal vein very short, not or scarcely so long as the marginal and postmarginal veins united; axillæ either meet at their inner basal angles or they are separated.................................... 47

Stigmal vein much longer than the marginal, as long or longer than the marginal and postmarginal veins united; the axillæ do not meet at their inner basal angle.............................. 46

46. Lateral ocelli not close to the eye border; club of antennæ not much enlarged, only about half the length of the funicle, the joints of the funicle cylindrical, much longer than wide, never moniliform; abdomen conic-ovate, usually a little longer than the head and thorax united. **Pseudencyrtus** Ashmead (type *Encyrtus cecidomyiæ* How.).

Lateral ocelli close to the eye border; club of antennæ not one third the length of the funicle, the joints of the funicle gradually thickening to the club, wide, joints 1 to 5 a little longer than thick, the sixth quadrate; abdomen short-ovate, shorter than the thorax. **Tachardiæphagus** Ashmead, gen. nov. (type *T. thoracicus* Ashm.).

47. Stigmal vein not longer than the marginal and postmarginal veins united, usually distinctly shorter than the marginal.

Postmarginal vein longer than the stigmal.

Club of antennæ short, not one third the length of the funicle, funicle joints 1 to 4 shortening, not longer than thick; axillæ meet at base of scutellum; head sublenticular-

with some sparse punctures, the lateral ocelli away from the eye border; abdomen ovate, flat above, not longer than the thorax..... **Tachinæphagus** Ashmead, gen. nov. (type *T. zealandicus* Ashm.).

Postmarginal very short, or shorter than the stigmal.

Club of the antennæ much enlarged, usually as long or nearly as long as the funicle, or a little longer, and obliquely truncate from beneath, the joints of the funicle, or at least the first three or four joints, moniliform, or not longer than thick, the others transverse; abdomen ovate, rarely longer than the head and thorax united, most frequently the length of the thorax or a little longer........................ **Epiencyrtus** Ashmead (type *Encyrtus thyreodontis* Ashm.).

Club of antennæ not much enlarged, nor obliquely truncate from beneath, fusiform, and less than half the length of the funicle, none of the funicle joints wider than long; abdomen short ovate, hardly as long as the thorax........... **Syrphophagus** Ashmead (type *Encyrtus mesograptæ* Ashm.).

Stigmal vein very short, scarcely so long as the marginal and postmarginal veins united, the former being not more than, or hardly, twice as long as thick, the postmarginal vein never well developed, although acuminate and longer than the short marginal; club of antennæ oblong, stouter, and a little more than half the length of the funicle, the first two or three joints of the funicle short or moniliform, the following a little longer than thick, or at most with only the last two joints a little wider than long; abdomen broadly oval and considerably shorter than the thorax; scutellum variable, subopaquely sculptured or polished, impunctate, the axillæ not quite meeting at their inner basal angles........................ **Aphidencyrtus** Ashmead (type *Encyrtus aphidiphagus* Ashm.).

48. Winged.. 49

Apterous.

Scutellum triangular, acute at apex, not declivous; head with the scrobes deep; antennæ simple.................................. **Choreia** Westwood (type *Encyrtus ineptus* Dalm.).

49. Head with the face much inflexed, the scrobes deep, semicircular, the frons most frequently regularly or very minutely, feebly punctate... 50

Head always semiglobose, the face less distinctly inflexed, the scrobes, however, always forming a semicircle; antennæ simple, or at least never much compressed, nor very broad, subcylindrical; wings not fusco-radiate; scutellum with a clump of hairs at apex.......... **Cheiloneurus** Westwood (type *C. formosus* Westw.).

50. Wings fuscous, usually with the extreme tips white or hyaline.................................. 52

Wings not so colored.

Wings with fuscous rays, or with leopard-like spots..................................... 51

Wings hyaline or at most with a discoidal cloud; antennæ short.

Eyes large, rounded, strongly convergent above and leaving a very narrow or linear vertex; antennæ very short, the club enormously enlarged, longer than the funicle and several times thicker, the joints of the funicle transverse....... **Zaomma** Ashmead (type *Encyrtus argentipes* How.).

Eyes not unusually large, only slightly converging above, the vertex not especially narrow; club of antennæ not unusually enlarged and about the length of the funicle, the joints of the funicle transverse, the first two or three submoniliform. **Adelencyrtus** Ashmead (type *Encyrtus chionaspidis* How.).

51. Wings with leopard-like spots; antennæ very long and slender, longer than the body, the club enlarged.................................. **Callipteroma** Motschulsky (type *C. 5-signatus* Motsch.).

Wings with fuscous rays.

Head oblong; antennæ strongly compressed, broad; occipital margin and the scutellum normal. **Cerapterocerus** Westwood (type *C. mirabilis* Westw.).

Head *not* oblong; antennæ neither strongly compressed nor broad; occipital margin medially and superiorly, with two strong clavate hairs; scutellum at apex with one or two clumps of hairs; marginal vein more than twice as long as thick.

Funicle 6-jointed, the joints wider than long, the club not especially large. **Habrolepis** Förster (type *Encyrtus dalmani* Westw.).

Funicle 4-jointed, the joints fully twice as long as thick, or a little longer, the club very large, fusiform, nearly as long as the funicle and much stouter. **Homalopoda** Howard (type *H. cristata* How.).

52. Marginal vein shorter than the stigmal or no longer.. 55

Marginal vein longer than the stigmal; facial impression not bounded by a distinct arched carina superiorly.. 53

53. Scutellum *without* a tuft of black bristles near apex.. 54

Scutellum *with* a tuft of black bristles near apex.

Head with a series of moderately large punctures; axillæ very narrow, transversely wedge-shaped, with the points just meeting at base of the scutellum; antennæ compressed, the scape wide..........................**Eusemion** Dahlbom (type *Encyrtus corniger* Haliday).

Head microscopically punctate; axillæ with their points not quite meeting; antennæ strongly clavate, subcompressed, the scape subclavate, the club very large, many times larger than the funicle, the joints of the latter transverse, linear...........**Blatticida** Ashmead, g. nov. (type *B. pulchra* Ashm.).

54. Head smooth, shining, with very fine, sparse punctures; ocelli in an acute triangle; axillæ united at base of the scutellum..................................**Atropates** Howard (type *A. collinsi* How.).

55. Facial impression not bounded by an arched carina superiorly.................................. 57

Facial impression and scrobes deep, bounded by a distinct arched carina superiorly.

Scutellum *without* a tuft of bristles.. 56

Scutellum *with* a tuft of bristles.

Stigmal and postmarginal veins very long..................**Chrysoplatycerus** Ashmead (type *Rileya splendens* How.).

56. Marginal and postmarginal veins subequal, the stigmal a little the longer; eyes naked; ocelli in an acute triangle; funicle not longer than the first joint of the club.............. **Asteropæus** Howard (type *A. primus* How.).

Marginal longer, the stigmal and postmarginal veins not long; eyes pubescent; joints of the funicle all short and rapidly widening from the narrow pedicel, the club longer than the funicle, obliquely truncate from beneath towards apex; tarsi short and somewhat thickened....... **Anicetus** Howard (type *A. ceylonensis* How.).

57. Scutellum normal; eyes pubescent; antennæ short, the scape somewhat broadly dilated toward apex; the flagellum strongly incrassated, scarcely longer than the scape, the very large club longer than the funicle, the joints of funicle annular; marginal vein punctiform, the stigmal and postmarginal veins very long as in *Encyrtus*......................**Zarhopalus** Ashmead (type *Z. sheldoni* Ashm.).

58. Antennæ 10-jointed, the funicle 5-jointed.

Scape linear, wholly received in the scrobes; marginal vein punctiform...... **Metallon** Walker (type *M. acacallis* Walk.).

Antennæ 9-jointed, the funicle 4-jointed .... **Cercobelus** Walker (type *C. jugæus* Walk.).
Antennæ 6-jointed, the funicle 3-jointed...................... **Coccobius** Ratzeburg (type unknown.)

59. Mandibles with the teeth shorter, less acute; labrum not conspicuous; frons punctate and frequently with a series of large, thimble-like punctures; wings often ornate, sometimes wanting or abbreviated 65

Mandibles rather long, with acute teeth, the apical one usually larger and more acute than the other two; labrum conspicuous; frons very closely punctate or shagreened, the large punctures wanting; front wings not ornate, usually with a punctiform or very short marginal vein, the hind wings usually with a long costal cell, which extends to the hooklets; head, as seen from in front, rather narrow and long, subtriangular, the scrobes forming a triangle.

Postmarginal vein wanting or hardly developed, the marginal vein very short, punctiform. 60
Postmarginal vein distinct, longer than the stigmal vein................................... 64

60. Head, viewed from in front, much longer than wide, the cheeks long 61
Head, viewed from in front, not longer than wide, the cheeks not long................................ 63

61. Front wings *with* marginal cilia.. 62
Front wings *without* marginal cilia.

Antennæ very long and slender, the flagellar joints all very long, the sixth the shortest, but five times as long as wide.. **Psilophrys** Mayr.

62. Pedicel three or more times longer than thick at apex, the flagellum with long hairs.

Funicle joints about four times as long as thick, cylindrical; mesonotum and scutellum shagreened .... **Parapsilophrys** Howard.
Funicle joints less than thrice as long as thick; mesonotum reticulate........ **Liothorax** Mayr.

Pedicel not three times as long as thick, the flagellum clothed with long hairs.
Copidosoma Ratzeburg.

63. Cheeks about half the length of the eyes; funicle joints 1–5 triangularly toothed, with long hairs.
Prionomitus Mayr.

Cheeks very short; eyes large, rounded, pubescent; pedicel thrice as long as thick.
Archinus Howard.

64. Mesonotum lustrous, smooth, blue or metallic.

Pedicel about thrice as long as thick, the flagellum filiform or subfiliform, with a short, sparse pubescence, the funicle joint from two and a half to three times as long as thick; the first joint very long, four or more times longer than thick; eyes pubescent; postmarginal vein very long.. **Parencyrtus** Ashmead.

65. Abdomen with the dorsum flat or concave, not rigidly pubescent................................ 66
Abdomen subglobose or subovate, clothed with a rigid white pubescence.

Pronotum large, conical; antennæ strongly compressed, broad; wings wanting or poorly deoped, not extending to middle of abdomen................................ **Mira** Schellenberg.

Pronotum not large; antennæ simple, neither compressed nor broad.

Head, seen from in front, much longer than wide; marginal vein not short; antennæ long, the flagellum subclavate, clothed with a soft, dense pubescence. **Sphæropisthus** Thomson.

Head, seen from in front, not longer than wide; marginal vein very short, the postmarginal vein longer than the stigmal; flagellum filiform, the joints nearly thrice as long as thick.
Chestomorpha Ashmead.

66. Head not or less distinctly lenticular, opaque, minutely, closely punctate, shagreened, or smooth and shining, at the most with only a few large punctures.. 70

Head transversely broad, always lenticular, the scrobes short, the punctures large, thimble-like; hind wings with the costal cell usually extending to the hooklets.

Marginal vein rarely short, at least longer than thick, and usually much longer; mesonotum smooth, impunctate, or at most shagreened... 68

Marginal vein very short, punctiform, not or scarcely longer than thick; mesonotum punctate.

Mesonotum with the punctuation unlike that of the head, the punctures less dense and the surface finely coriaceous; postmarginal and stigmal veins short, subequal...... 67

Mesonotum with the punctuation similar to that of the head; postmarginal vein very short or subobsolete (rarely long), the stigmal vein long.

Scape normal, *without* a leaf-like expansion beneath.

Punctures on head and thorax coarse and dense.

Mesonotum very short, only about half the length of the scutellum; postmarginal vein usually as long as the stigmal; flagellum long, with long sparse hairs, not arranged in half whorls..........**Chalcaspis** Howard.

Mesonotum at least as long as the scutellum or very nearly; postmarginal vein much shorter than the stigmal; flagellum with funicle joints subexcised at apex, with half whorls of long hairs.

Bothriothorax Ratzeburg.

Punctures on head and thorax small and less dense; mesonotum a little longer than the scutellum.............................**Aratus** Howard.

67. Vertex and face broad, finely shagreened, and sparsely punctate; scrobes deep, semicircular.

Pedicel obconical, longer than thick at apex, the flagellum subclavate, the joints, after the first, wider than long..**Pentelicus** Howard.

Pedicel very minute, the flagellum filiform, pilose, the joints subequate, about two and one half times as long as thick..**Blepyrus** Howard.

Vertex and face very narrow, or not broad.

Head with coarse thimble-like punctures, the thorax smooth, impunctate; flagellum short, thick, filiform, clothed with a dense short pubescence, the joints wider than long.

Ænasius Walker.

Head smooth without coarse thimble-like punctures, at the most with some sparse punctures on the vertex; flagellum long, subclavate, not thick and only sparsely pubescent.

Euryrhopalus Howard.

68. Marginal vein rather long, rarely shorter than the stigmal...................................... 69

Marginal vein rarely more than twice as long as thick; head with rather sparse, scattered, umbilicate punctures, the scutellum a little longer than the mesonotum.

Head not wider than the thorax between the wings; flagellum not short, filiform, and clothed with rather short sparse hairs, the funicle joints longer than wide, the first a little the longest.

Hemencyrtus Ashmead.

Head wider than the thorax between the wings; flagellum short, strongly clavate, as in the female; the club large and longer than the funicle, the joints of the latter minute, annular.

Coccophoctonus Ashmead.

69. Mesonotum as long as the scutellum or nearly, rarely somewhat shorter, the surface finely shagreened, at most with some feebly defined sparse punctures; marginal vein shorter than the stigmal, the latter not very short; flagellum filiform, pilose, the funicle joints about twice as long as thick; eyes bare...**Phænodiscus** Förster.

Mesonotum much shorter than the scutellum, finely delicately shagreened or rugulose, especially anteriorly; marginal vein a little longer than the stigmal; flagellum subclavate, densely pubescent, the funicle joints 2–6 not longer than thick, if anything a little wider than long; eyes pubescent. **Rhytidothorax** Ashmead.

70\. Antennæ inserted near the mouth border or far below the middle of the face.................... 71

Antennæ inserted on or a little above the middle of the face.

Frons subconvex, somewhat coarsely and closely punctate; thorax rather coarsely shagreened or finely rugulose; scape not extending beyond ocelli; front wings with the marginal, postmarginal and stigmal veins long, subequal........................... **Tanaoneura** Howard.

Frons highly convex, smooth and polished, as is also the thorax; scape long, extending far beyond the ocelli; front wings with the marginal, postmarginal and stigmal veins rather short, the marginal thickened with a fuscous cloud or band beneath; flagellum with six long branches.. **Hexacladia** Ashmead.

71\. Antennæ with the funicle 2-, 3-, 4- or 5-jointed.. 89

Antennæ with the funicle 6-jointed (in a single case 2-jointed).

Metathorax bare, or with the lateral ridges superiorly alone pilose........................ 75

Metathorax with the pleura and the lateral ridges always clothed with a dense silvery pubescence; body rather robust.. 72

72\. Antennæ unlike those of the female, filiform, pilose, or with whorls of hairs, or the funicle joints dentate or subpedunculate, with whorls or fascicles of hairs.. 73

Antennæ similar to those of the female, filiform or at most subclavate, the club conical, strongly obliquely truncate from beneath, often white, the scape cylindrical, not at all dilated; front wings usually with a discoidal fuscous cloud or macula.

Marginal vein *not* punctiform, although short, the stigmal and postmarginal veins long, very much longer than the marginal...................................... **Homalotylus** Mayr.

Marginal vein punctiform, the stigmal vein long, the postmarginal vein not developed or wanting.. **Isodromus** Howard.

73\. Marginal and postmarginal veins not very short, the former usually a little longer than the stigmal, rarely somewhat shorter.

Thorax without white lunulæ before the tegulæ.. 74

Thorax, with white lunulæ, or at least a dot, before the tegulæ......... **Cerchysius** Westwood.

74\. Hind wings, with the costal cell short and narrow.

Antennæ long; the flagellum long, cylindrical, clothed with long, sparse hairs; the funicle joints long.. **Sceptrophorus** Förster.

Hind wings with the costal cell broad and extending as far as the hooklets.... **Echthroplexis** Förster.

75\. Head with the frons prominent, the face inflexed; antennæ frequently compressed, dilated, broad; front wings usually with fuscous rays or fuscous with white tips, more rarely hyaline; sometimes apterous or subapterous; marginal vein usually somewhat thickened, oblong, very rarely much longer or much shorter than the stigmal, the postmarginal frequently wanting......................... 83

Head, as seen from the side, with the frons not prominent; wings most frequently hyaline, although sometimes with transverse fuscous bands or fuscous with white bands.

Marginal vein not short, punctiform, but rarely longer than the stigmal, always more than twice longer than thick, the postmarginal most frequently well developed, rarely somewhat shorter than the marginal.. 77

Marginal vein very short, punctiform, rarely longer than thick, the stigmal from two and a half to three times or more longer than the marginal; the postmarginal wanting or very short,

not well developed, scape slender or at most subclavate, never dilated; frons usually rather narrow, the eyes, as seen from in front, slightly converging above.

Scape slender, or at most subclavate; frons rather narrow 76

Scape and flagellum abnormally compressed and broad, the funicle joints 1 to 4 wider than long ....**Mirocerus** Ashmead, n. g. (type *M. peyelæ* Ashm.).

76. Flagellum with the hairs on the funicle joints not arranged in half whorls.

Lateral ocelli touching the eye margin; flagellum with long hairs.

Eyes bare; postmarginal vein not developed or so slightly developed as not to be considered..**Oöencyrtus** Ashmead.

Eyes pubescent; postmarginal vein as long as the marginal..**Ageniaspis** Dahlbom (part).

Lateral ocelli not close to the eye margin; postmarginal vein somewhat developed; flagellum filiform, with a short pubescence..................................**Psyllæphagus** Ashmead.

Flagellum with the hairs on the funicle joints arranged in half whorls......**Coccidencyrtus** Ashmead.

77. Species metallic or submetallic 78

Species *not* metallic; head and thorax opaque or subopaque, alutaceous, closely microscopically punctate or shagreened, and pubescent.

Postmarginal vein present.

Pedical longer than the first joint of funicle; flagellum clothed with hairs, the funicle joints, except the first two or three joints, not or scarcely longer than thick. **Aphycus** Mayr.

Pedicel very short; flagellum elongate, the club only slightly enlarged, the funicle joints elongate, cylindrical, and clothed with sparse, long hairs....**Heterarthrellus** Howard.

Postmarginal vein wanting.

Pedicel as long as the first funicle joint; flagellum subclavate, the club not quite so long as funicle joints 4–6 united, first joint of funicle the longest, the following gradually shortening, clothed with a short, rather dense pubescence......**Astymachus** Howard.

78. Thorax *without* a scaly pubescence, and *without* white lunulæ before the tegulæ.................. 79

Thorax *with* a scaly pubescence, and *with* white lunulæ before the tegulæ.

Flagellum elongate, the funicle joints long, excised or subexcised at apex with whorls of long hairs..**Blastothrix** Mayr.

79. Scape normal, not expanded or dilated beneath, at the most subclavate; wings hyaline 80

Scape usually dilated or expanded beneath, or at least with a carina, rarely simple, unlike the female; wings fuscous or subfuscous, with transverse hyaline bands, rarely hyaline.

Thorax smooth but microscopically coriaceous, with sparse punctures scattered over the surface; frons with a series of punctures, especially on the orbits...............**Microterys** Thomson.

80. Thorax finely coriaceous, subopaque, without punctures scattered over the surface; frons punctate; scutellum with a delicate impressed median line; wings pubescent, with an oblique hairless line from base of stigmal vein; flagellum subfiliform, clothed with a short, dense pubescence, the funicle joints a little wider than long...**Holcencyrtus** Ashmead.

Thorax smooth, impunctate, or at the most microscopically reticulate, or with fine longitudinal striæ on the mesonotum.

Mesonotum smooth, impunctate, or at the most microscopically reticulate.................. 81

Mesonotum with fine longitudinal striæ.

Stigmal vein scarcely longer than the marginal, the postmarginal vein longer than the marginal and stigmal veins united; eyes pubescent.............**Ageniaspis** Dahlbom.

81. Stigmal vein very short, *not* or scarcely so long as the marginal and postmarginal veins united ; axillæ meet at their inner basal angles.. 82

Stigmal vein much longer than the marginal, as long or longer than the marginal and postmaginal veins united ; axillæ do not quite meet at their inner basal angles.

Antennæ with the scape rather short and stout, not reaching to the front ocelli, the flagellum elongate filiform, clothed with sparse moderately long hairs, the funicle joints about thrice as long as thick, or nearly..**Pseudencyrtus** Ashmead.

Antennæ with the scape long, slender, reaching to or beyond the front ocellus, the flagellum elongate filiform, the funicle joints more than twice longer than wide, with long sparse hairs ; scutellum shagreened or striate.......................................**Microterys** Thomson (part).

82. Stigmal vein *not* longer than the marginal and postmarginal veins united, usually distinctly shorter, the postmarginal very short, or shorter than the stigmal.....................**Epiencyrtus** Ashmead.

Antennæ with the scape short, not extending beyond the middle of the face, the flagellum filiform, sparsely pilose, the funicle joints about two and a half times as long as thick ; lateral ocelli about or nearly twice their width from the eye margin.......**Syrphophagus** Ashmead.

Stigmal vein very short, not so long as the marginal and postmaginal united, the former being not more than or hardly twice as long as thick, the postmarginal never well developed, although acuminate and longer than the short marginal.

Flagellum filiform, pilose, the joints of funicle about twice as long as thick ; lateral ocelli at least their width from eye margin..............................**Aphidencyrtus** Ashmead.

83. Scutellum neither triangular nor acute at apex.. 84

Scutellum triangular, acute at apex.

Antennæ simple, subfiliform, pubescent..................................**Choreia** Westwood.

84. Funicle 6-jointed 85

Funicle 2-jointed, the club unusually long and cylindrical (teste Mayr)............**Habrolepis** Förster.

85. Head with vertex antero-posteriorly broad, the face much inflexed, the frons regularly punctate ; antennæ with the scape and flagellum usually strongly compressed, broad ; wings fuscous or with fuscous rays.. 86

Head always semiglobose, the face less distinctly inflexed, the scrobes always forming a semicircle ; antennæ simple, filiform, the joints long, cylindrical, distinctly separated and hairy, rarely slightly compressed ; wings usually fusco-radiate or partly fuscous, rarely entirely hyaline.

Scape elongate, extending to or beyond the front ocellus, the flagellum very long, clothed with rather long hairs..**Cheiloneurus** Westwood.

86. Wings fuscous, with narrow white tips.. 87

Wings hyaline, the marginal vein rather long, stout, as long as the stigmal vein, the latter not short, the postmarginal not developed ; antennæ long, filiform, the flagellum with sparse moderately long hairs ; funicle joints 1–6 constricted at apex or subpedunculate, somewhat similar to the male in *Eurytoma*...**Cerapterocerus** Westwood.

87. Marginal vein shorter than the stigmal.. 88

Marginal vein longer than the stigmal.

Facial impression not bounded by a distinct carina superiorly ....**Eusemion** Dahlbom.

88. Facial impression and scrobes deep, bounded by a high carina superiorly.

Scutellum with a tuft of bristles ; stigmal and postmarginal veins very long.

Chrysoplatycerus Ashmead.

Scutellum *without* a tuft of bristles ; stigmal and postmarginal veins not long. **Anicetus** Howard.

Facial impression not bounded by a carina superiorly ....**Zarhopalus** Ashmead.

89. Antennæ 10-jointed, with a 5-jointed funicle..**Metallon** Walker.
Antennæ 9 jointed, the funicle 4-jointed..**Corcobelus** Walker.
Antennæ 6-jointed, the funicle 3-jointed..**Coccobius** Ratzeburg.
Antennæ 5-jointed, the funicle 2-jointed, the club unusually long and cylindrical....**Habrolepis** Förster.

Tribe IV. *Arrhenophagini.*

In this tribe the mandibles are acutely pointed, or conical, and edentate; tarsi 4 or 5-jointed, while the marginal vein, in the front wings, is wanting or punctiform, the postmarginal vein being absent. The stigmal vein is sometimes present.

TABLE OF GENERA.

1. Tarsi 4-jointed.. 2
Tarsi 5-jointed.
Front wings with the marginal vein punctiform, the postmarginal wanting, the stigmal vein rather short and curved; ♀ with 10-jointed antennæ, the funicle 5-jointed, joints 1–3 small, wider than long; ovipositor exserted........**Rhopoideus** Howard (type *R. citrinus* How.).
2. Front wings with the marginal and stigmal veins wanting, the subcostal vein not quite attaining the costal edge and ending in a stigma; ♀ with 3-jointed antennæ, ♂ with 9-jointed antennæ.
Arrhenophagus Aurivillius (type *A. chionaspidis* Auriv.).

Subfamily III. Signiphorinæ.

1894. Signiphorinæ, Subfamily, Howard, Ins. Life, VI., p. 234.
1897. Signiphorinæ, Subfamily III., Ashmead, Proc. Ent. Soc. Washington, IV., p. 248.

This subfamily was established by Dr. L. O. Howard, in 1894, and was based upon my genus *Signiphora,* described in 1880, from specimens bred in Florida from the purple scale, *Aspidiotus citricola* Packard. Many species have since been discovered from different parts of the world, and the group, although at present represented by a single genus, has evidently a wide distribution. The species destroy scale insects, *Coccidæ,* and the mealy-winged flies, *Aleurodidæ.*

Antennæ apparently 3-jointed but in reality 6-jointed, there being 3 minute ring-joints easily overlooked; wings with a long marginal fringe, the marginal vein long, about the length of the subcostal vein, the stigmal vein distinct but not long, the postmarginal vein absent; middle tibiæ with a large, lobed apical spur, and with lateral spurs or strong bristles.
Signiphora Ashmead (type *S. flavopalliata* Ashm.).

Family LXIX. PTEROMALIDÆ.

1835. Pteromalidæ, Family (partim), Walker, Ent. Mag., II., p. 286.
1840. Pteromalides, Subfamily 3 (partim), Westwood, Intro. Mod. Class. Insect, II., p. 166; Synop., p. 67.
1846. Spalangiidæ, Family 7 (partim), Walker, List. Chalc. Brit. Museum, I., p. 23.
1846. Pteromalidæ, Family 8 (partim), Walker, *opus cit.,* p. 23.

1856. Ormoceroidæ, Family XV. (partim), Förster, Hym. Stud., II., p. 59.
1856. Pteromaloidæ, Familie 16 (partim), Förster, *opus cit.*, pp. 19, 25 and 63.
1875. Pteromalina Tribus (partim), Thomson, Hym. Skand., IV., pp. 12 and 217.
1886. Pteromalinæ, Subfamily (partim), Howard, Ent. Amer., I., p. 198.
1897. Pteromalidæ, Family LXIX., Ashmead, Proc. Ent. Soc. Washington, IV., p. 246.

This is the largest and most difficult family to classify of all of the families of the superfamily Chalcidoidea. It comes nearest to the family *Miscogasteridæ*, and is separated from it by a single character — the tibial spurs of the hind legs. In this family the hind tibiæ have *one* apical spur, in the *Miscogasteridæ two.*

Six subfamilies have been recognized, and these are again divided into tribes. The subfamilies may be recognized by the aid of the following table:

TABLE OF SUBFAMILIES.

1. Abdomen sessile or subsessile 2
   Abdomen distinctly petiolate 4
2. Metanotum *without* spiracular sulci and usually without lateral folds 3
   Metanotum *with* spiracular sulci, always present, the lateral folds also present although sometimes incomplete, the median carina usually more or less distinct, rarely absent; antennæ 12 to 13-jointed.
   Subfamily I. PTEROMALINÆ.
3. Head normal, not especially wide; antennæ 12 to 13-jointed; scutellum of normal size; hind angles of metanotum rounded .... Subfamily II. MERISINÆ.
   Head very wide, much wider than the thorax, lenticular; antennæ 6 to 10-jointed, inserted near the mouth border; scutellum large; hind angles of metanotum acute .... Subfamily III. EUNOTINÆ.
4. Front wings with the marginal vein very long, the costal cell very narrow; head transverse, convex anteriorly 6
   Front wings with the marginal vein not especially long, often short and thick, the costal cell rarely narrow; if very narrow the head is oblong; apterous forms not uncommon 5
5. Head viewed from in front short or rounded, the occipital line incomplete; antennæ 9 to 13-jointed.
   Subfamily IV. SPHEGIGASTERINÆ.
   Head viewed from in front oblong, the occipital line complete; antennæ 8 to 12-jointed.
   Subfamily V. SPALANGIINÆ.
6. Mesonotum rather long; head in front convex; antennæ 13-jointed, the scape long, reaching beyond the ocelli .... Subfamily VI. DIPARINÆ.

SUBFAMILY I. PTEROMALINÆ.

1897. Pteromalinæ, Subfamily II., Ashmead, Proc. Ent. Soc. Washington, IV., p. 236.
1900. Pteromalinæ, Subfamily II., Ashmead, Proc. U. S. Nat. Museum, XXIII., p. 248.

The *sessile,* not distinctly petiolate, abdomen separates this group from the *Sphegigasterinæ*, *Spalangiinæ* and the *Diparinæ,* while the shape of the head, scutellum,

metathorax and the greater number of joints in the antennæ readily separate it from the *Eunotinæ.*

Large subfamilies, I think, should be separated into tribes, in order to facilitate quicker the recognition of genera and to show better their affinities.

I have, therefore, recognized *four* tribes, based upon the number of teeth in the mandibles.

TABLE OF TRIBES.

1. Both mandibles *not* 3-dentate 2
   Both mandibles 3-dentate .... Tribe I. Metaponini.
2. Left mandible 3-dentate, the right 4-dentate.
   Antennæ inserted on or near the middle of the face, always above an imaginary line drawn from the base of the eyes .... Tribe II. Raphitelini.
   Antennæ inserted far below the middle of the face, on or below an imaginary line drawn from the base of the eyes .... Tribe III. Eutelini.
   Both mandibles 4-dentate .... Tribe IV. Pteromalini.

Tribe I. *Metaponini.*

The three dentate mandibles distinguish the tribe. All of the species, so far as the records go, with a single exception, are parasites of coleopterous larvæ.

TABLE OF GENERA.

1. Females 2
   Males 11
2. Head triangular, narrowed towards the mouth, eyes large, rounded, convex; presternum large, mesosternal furrow distinct; metathoracic spiracles rounded, remote from the postscutellum 3
   Head not triangular, viewed from in front, more rounded, very slightly wider than long; eyes oblong-oval or oval; presternum not large; mesosternal furrow not distinct; vertex broad; metathoracic spiracles not rounded 5
3. Vertex not acute medially 4
   Vertex broad, acute medially, the frons impressed.
   Abdomen conically pointed .... **Etroxys** Westwood (*E. scenicus* Westw.).
4. First joint of funicle large, fully twice as long as thick.
   Holcæus Thomson (type *Etroxys dichrous* Dalm.).
   First joint of funicle small, not or hardly 1½ times as long as thick.
   Cricellius Thomson (type *C. decipiens* Thoms.).
5. Club of antennæ not white 6
   Club of antennæ white or yellowish.
   Metathorax short, with a small subglobose neck, punctate, the spiracles small, rounded; head transverse, wider than the thorax; antennæ inserted near the middle of the face, the flagellum subfiliform, the first joint of the funicle the largest.
   Chrysoglyphe Ashmead (type *C. apicalis* Ashm.).
6. Antennæ much thickened toward apex, clavate 10
   Antennæ not much thickened toward apex, filiform or at most subclavate 7

7. Hind coxæ not small, the posterior margin at base hairy ; abdomen not rotund.......................8
Hind coxæ small, subovate, the posterior margin at base not hairy ; abdomen rotund ; head large, wider than the thorax.........................**Dirhicnus** Thomson (type *D. subcœruleus* Thoms.).
8. Antennæ with *three* ring-joints.. 9
Antennæ with *two* ring-joints.
Collar not distinctly separated ; flagellum filiform, the pedicel obconical, shorter than the first joint of the funicle ; metathorax not short, punctate, with a median carina, the spiracles oval ; abdomen elongate, longer than the thorax ....**Stinoplus** Thomson (type *E. militaris* Thoms.).
Collar narrowed medially ; flagellum filiform, the pedicel small, a little longer than thick ; metathorax without a median carina, the spiracle oval ; abdomen elongate, pointed toward apex, and longer than the head and thorax........**Spintherus** Thomson (type *S. obscurus* Thoms.).
9. Pronotum as wide as the mesonotum, distinctly separated, and with the anterior margin acute ; metathorax short, punctate, with a small globose neck and without a median or transverse carina, the spiracles subreniform ; flagellum subfiliform, hardly thickened towards apex ; abdomen ovate, hardly longer than the thorax ; marginal vein not longer than the stigmal vein.
Bruchobius Ashmead, g. nov. (type *B. laticeps* Ashm.).
Pronotum narrower than the mesonotum, the anterior margin not acute ; metathorax with a subglobose neck, punctate, and with usually median and transverse carinæ or at least with one or the other present, the spiracles oval or ellipsoidal, *not* reniform ; flagellum filiform or subfiliform.
Metanotum with a transverse carina near the base, the median carina wholly absent ; marginal vein long, a little more than twice the length of the stigmal vein.
Lophocomodia Ashmead (type *L. americana* Ashm.).
Metanotum with transverse and median carinæ present ; marginal vein not long, not or hardly longer than the stigmal vein..**Psilocera** Walker.
= *Eupsilocera* Westwood = *Dichalysis* Förster (type *P. obscura* Walk.).
10. Flagellum with *three* ring-joints ; scutellum normal ; metathorax with the median and transverse carinæ usually present although sometimes the transverse fold is vaguely defined or absent, the spiracle oval ; abdomen subcompressed beneath toward apex, the hypopygium prominent.
Metapon Walker (type *M. atrum* Walker).
Flagellum with *two* ring-joints ; scutellum hardly elevated and produced into a blunt conical spine posteriorly ; metathorax with median and transverse carinæ present, the spiracles large, elongate oval ; abdomen compressed, the hypopygium prominent, plowshare-shaped.
Acanthometapon Ashmead, g. nov. (type *A. clavicornis* Ashm.).
11. Head triangular, narrowed towards the mouth ; eyes large, rounded, or oblong-oval, convex ; presternum large ; mesosternal furrows distinct ; metathoracic spiracles rounded, remote from the postscutellum.. 12
Head not triangular, viewed from in front more rounded, usually very slightly wider than long ; eyes oblong-oval or oval ; presternum not large ; mesosternal furrow not distinct ; vertex broad ; metathoracic spiracles *not* rounded.. 14
12. Vertex not acute medially.. 13
Vertex broad, acute medially ; antennæ long, the flagellum filiform, the funicle joints long.
Etroxys Westwood.
13. Antennæ subclavate ; metathoracic spiracles small, round.......................**Holcæus** Thomson.
Antennæ filiform ; metathoracic spiracles oval, or not round....................**Cricellius** Thomson.
14. Tip of antennæ not white.. 15
Tip of antennæ white...**Chrysoglyphe** Ashmead.

15. Hind coxæ not small, the hind margin towards base hairy 16
Hind coxæ small, the hind margin not hairy.................................. **Dirhicnus** Thomson.
16. Antennæ with *two* ring-joints.. 17
Antennæ with *three* ring-joints.. 18
17. Scutellum posteriorly highly elevated and produced into a spine.........**Acanthometapon** Ashmead.
Scutellum normal, not spined.
Collar not distinctly separated...**Stinoplus** Thomson.
Collar narrowed medially...**Spintherus** Thomson.
18. Pronotum not broad, narrower than the mesonotum... 19
Pronotum broad, as wide as the mesonotum.................................**Bruchobius** Ashmead.
19. Flagellum filiform, the joints cylindrical, those of the funicle very briefly pedicellate, hairy but not verticillate.. 20
Flagellum filiform, the joints of the funicle nodose-verticillate.
Metanotum without a median carina; marginal vein more than twice the length of the stigmal vein...**Lophocomodia** Ashmead.
Metanotum with a median carina; marginal vein not or only a little longer than the stigmal vein...**Psilocera** Walker.
20. Metathorax with the median and transverse carinæ usually present, the spiracles oval.
Metapon Walker.

Tribe II. *Rhaphitelini.*

In this tribe the left mandible is 3-dentate, the right 4-dentate, as in the tribe *Eutelini*, from which it is, however, easily distinguished by the insertion of the antennæ; these are inserted on or near the middle of the face, and *not* low down, near the mouth border, as in the *Eutelini*.

TABLE OF GENERA.

1. Females.. 2
Males.. 14
2. Front femora considerably swollen.. 3
Front femora normal.
3. Metathorax with a median carina and with the lateral folds complete, rarely abbreviated, the spiracles small, rounded or broadly oval, and lying close to the postscutellar fold.
Marginal vein in front wings *thickened*.. 4
Marginal vein in front wings normal, *slender*.. 7
4. Antennæ with ring-joints *small*, transverse or annular.. 5
Antennæ with the ring-joints *large*, not transverse.
Front coxæ cylindrical; knob of stigmal club obsolete.......................**Pandelus** Förster
(type *Cleonymus flavipes* Först.).
5. Metanotum *with* folds and a median carina... 6
Metanotum smooth, *without* folds.
Stigmal and postmarginal veins short; abdomen conic-ovate, keeled beneath; last joint of antennæ normal...............................**Metacolus** Förster (type *M. unifasciatus* Först.).
6. Stigmal vein longer than the marginal; last joint of the antennæ stylate; abdomen ovate, depressed, not keeled beneath...............................**Rhaphiteles** Walker (type *R. maculatus* Walk.).

7. Stigmal club, or knob, small; front margin of pronotum rounded; metanotum with a median carina, the lateral folds usually wanting or incomplete.. 8
Stigmal club very large; front margin of pronotum sharp; metanotum with the lateral folds usually complete.. **Dinotus** Förster (type *D. bidentulus* Först.).
8. Marginal vein at least thrice as long as the stigmal vein; clypeus anteriorly bidentate; metathorax impunctate, with a median carina............ **Rhopalicus** Förster (type *Cleonymus maculifer* Först.).
9. Clypeus at apex unarmed, either truncate, sinuate or incised.. 10
Clypeus at apex armed with a median tooth.
Thorax long, the pronotum with the front margin acute, laterally dilated, the metathorax with short folds. .... **Stenomalus** Thomson (type *S. crassicornis* Thoms.).
10. Stigmal vein ending in a small or median sized knob or club.. 11
Stigmal vein ending in a large knob or club.
Metathorax short and usually with a transverse carina; clypeus incised at apex medially; mesepisternum extending to the coxæ....... **Cecidostiba** Thomson (type *C. rugifrons* Thoms.).
Metathorax not short, usually with a fold and often also with a transverse carina; head and thorax usually with rigid pubescence........ **Cænacis** Thomson (type *C. grandiclava* Thoms.).
11. First joint of the flagellum always longer than the pedicel, or of an equal length.................. 12
First joint of the flagellum always shorter than the pedicel.. 13
12. Pronotum broad, the upper front margin rounded; scutellum with a cross-furrow before apex; abdomen conic-ovate, the second segment usually the largest, the third very short, segments 4–7 more than twice longer than the third, subequal, or very slightly increasing in length; marginal vein usually a little thicker at base than at apex..**Habrocytus** Thomson (type *Pteromalus albipennis* Walk.).
13. Pedicel as long as the ring-joints and the first two joints of the funicle united; metathorax produced into a subglobose neck, the lateral folds distinct, the spiracles large, subreniform; abdomen ovate.
Mormoniella Ashmead, g. nov. (type *M. brevicornis* Ashm.).
14. Front femora considerably swollen.. 15
Front femora normal.. 20
15. Marginal vein in front wings *thickened*.. 16
Marginal vein in front wings *slender*.. 18
16. Antennæ with the ring-joints *small*, annular.. 17
Antennæ with the ring-joints *large*, not annular................................ **Pandelus** Förster.
17. Metanotum smooth, without folds; stigmal and postmarginal veins short.......... **Metacolus** Förster.
Metanotum with folds and a median carina; stigmal vein longer than the marginal.
Rhaphiteles Walker.
18. Stigmal club or knob small.. 19
Stigmal club very large; front margin of pronotum acute .... **Dinotus** Förster.
19. Marginal vein very long; clypeus anteriorly bidentate........................... **Rhopalicus** Förster.
20. Clypeus at apex unarmed, truncate, sinuate or incised.. 21
Clypeus at apex armed with a median tooth.............................. **Stenomalus** Thomson.
21. Stigmal vein ending in a large knob.. 22
Stigmal vein ending in a small or moderate sized club.. 23
22. Clypeus at apex incised medially; metathorax short and usually with a transverse carina.
Cecidostiba Thomson.
Clypeus not incised; metathorax not short, usually with a fold and often also with a transverse carina; head and thorax usually with rigid bristles.............................. **Cænacis** Thomson.

23. Pronotum broad, the front margin acute; metathoracic spiracles oval or oblong; first joint of the funicle always longer than the pedicel.......................................**Habrocytus** Thomson.
   Pronotum not broad, the front margin not acute; first joint of the funicle much shorter than the pedicel...**Mormoniella** Ashmead.

Tribe III. *Eutelini.*

In its mandibular characters this tribe agrees with the *Rhaphitelini*, and is easily confused with the latter; but the antennæ are inserted differently, always low down on the face, usually close to the clypeus, *on* or *below* an imaginary line drawn from the base of the eyes.

The species falling in this group differ also in habits since they attack dipterous gall-makers, *Cecidomycidæ*, etc.

TABLE OF GENERA.

1. Females.. 2
   Males.. 7
2. Metathorax *with* distinct lateral folds.. 3
   Metathorax *without* lateral folds.
      Marginal vein not or only a little longer than the stigmal vein; metathorax long; first joint of the flagellum short.
         Antennæ inserted on an imaginary line drawn from the base of the eyes; abdomen not compressed, the ventral valve normal. **Amblymerus** Walker (type *A. dubius* Walk.).
         Antennæ inserted just above the clypeus, below such an imaginary line; abdomen compressed, the ventral valve prominent.....**Psilonotus** Walker (type *P. adamas* Walk.).
3. Thorax short; head with a rather narrow vertex, the ocelli arranged in a very short obtuse angle.. 4
   Thorax long; head with a broad vertex; ocelli large, in a triangle; pronotum with the front margin acute.. 5
4. Marginal vein about twice as long as the stigmal vein.......**Eutelus** Walker (type *E. vulgaris* Walk.).
   Marginal vein not nearly twice as long as the stigmal vein.
   Platymesopus Westwood (type *P. tibialis* Westw.).
5. Abdomen ovate, shorter than the thorax... 6
   Abdomen long, conically produced, triangularly compressed or carinate beneath.
      Marginal vein hardly twice as long as the stigmal vein.
      Platyterma Walker (type *P. nobile* Walk.).
      Marginal vein nearly thrice as long as the stigmal vein.
      Mesopolobus Westwood (type *M. fasciiventris* Westw.).
6. Marginal vein hardly longer than the stigmal vein; antennæ rather short, the flagellum subclavate, the pedicel long, obconical, the funicle joints wider than long; metathorax not short, with a median carina, the spiracles oval................**Nasonia** Ashmead, g. nov. (type *N. brevicornis* Ashm.).
7. Thorax short; head with rather a narrow vertex; ocelli arranged in a very obtuse angle.......... 8
   Thorax long; head with a broad vertex; ocelli large, arranged in a triangle........................ 9
8. Marginal vein about twice as long as the stigmal vein; middle tibiæ normal.........**Eutelus** Walker.
   Marginal vein not nearly twice as long as the stigmal vein; middle tibiæ broadly dilated.
   Platymesopus Westwood.

9. Marginal vein short, hardly longer than the stigmal vein 10
Marginal vein from about twice to thrice as long as the stigmal vein.
Marginal vein about twice as long as the stigmal vein; middle tibiæ normal.
Platyterma Walker.
Marginal vein nearly thrice as long as the stigmal vein; middle tibiæ with a small hirsute lobe outwardly near the tip .... **Mesopolopus** Westwood.
10. Metathoracic spiracles oval .... **Nasonia** Ashwood.

Tribe IV. *Pteromalini.*

To this tribe belong all species having both mandibles 4-dentate. It is a large tribe, with many genera and species, and some are of world-wide distribution.

Pteromalus puparum L. is the commonest and best known of all Chalcidoids, and is found in every hemisphere; it attacks various lepidopterous insects, *Pieris rapæ*, the cabbage butterfly, being especially subject to its attacks.

TABLE OF GENERA.

1. Females.. 2
Males 30
2. Occipital foraminal depression immargined...................................... 8
Occipital foraminal depression margined or rimmed.
Metathorax produced into a subglobose neck at apex, the median carina and lateral folds usually present.
Antennæ with 3 ring-joints.. 3
Antennæ with 2 ring-joints.. 4
3. Abdomen with the second segment large, the last segment produced into a long, slender, compressed stylus resembling an ovipositor.
Metathorax produced into a subglobose neck, punctate and tricarinate, the spiracles small, oblong; metopleural ridge fringed with white hairs.
Belonura Ashmead (type *B. singularis* Ashm.).
4. Eyes hairy; antennæ clavate, incrassate.. 5
Eyes bare; antennæ filiform or subclavate.. 7
5. Abdomen ovate or rotund, the second segment small or never occupying more than half the whole surface 6
Abdomen ovate, the second segment very large, occupying most of the surface, the third very small.. ....**Isocyrtus** Walker (type *I. lætus* Walk. ? = *breviventris* Walk.).
6. Abdomen ovate, the second segment occupying at most not more than half the surface, the third not small, two or more times longer than the fourth; tibiæ with rigid bristles; wings sometimes maculate, the postmarginal vein always longer than the stigmal.
Urolepis Walker = *Halizoa* Förster (type *Ormocerus maritimus* Walk.).
Abdomen rotund; wings immaculate, the postmarginal vein not longer than the stigmal, usually somewhat shorter.....................**Trichoglenes** Thomson (type *Pteromalus complanatus* Ratz.).
7. Abdomen ovate, the second segment occupying not more than one third the surface, the sides more or less fimbriate; funicle joints 4–6 a little wider than long, the club subulate.
Trichomalus Thomson (type *T. punctinucha* Thoms.).

8. Metathorax produced at apex into a subglobose neck; postmarginal vein always longer than the stigmal 9
   Metathorax *not* produced into a subglobose neck at apex, rarely with a small neck; postmarginal vein very rarely longer than the stigmal, most frequently shorter, or of an equal length 21
9. Pedicel always distinctly longer than the first funicle joint, more rarely of an equal length; the first joint of funicle usually the shortest of the funicle joints; metathoracic spiracles small, round, oval, long oval or elliptical 10
   Pedicel usually shorter than the first joint of the funicle, never longer; the first joint of the funicle usually the longest of the funicle joints; metathoracic spiracles large, oblong-oval or elliptical. 18
10. Antennæ with *two* ring-joints 11
   Antennæ with *three* ring-joints 17
11. Metathoracic spiracles oblong-oval, the lateral folds and the median carina present 12
   Metathoracic spiracles not oblong-oval 13
12. Abdomen conic-ovate, the third and fourth segments subequal, united as long as the second, the fifth hardly as long as the fourth or sixth; flagellum subclavate, the joints of the funicle gradually decreasing in length, not transverse; head wide, the temples oblique but rather broad.
   Polyscelis Dalla Torre (type *Pteromalus conspersus* Walk.).
   Abdomen ovate, pointed at apex, depressed above, keeled beneath; antennæ clavate.
   Paphagus Walker (type *P. sidæ* Walk.).
13. Metathorax with the lateral folds and usually the median carina present; abdomen ovate, beneath boat-shaped or carinate; flagellum clavate or subclavate, the club large, thicker than the funicle.
   Meraporus Walker (type *M. graminicola* Walk.).
   Metathorax with the lateral folds complete, the median carina absent; abdomen short oval, convex beneath; flagellum filiform or nearly, not or only slightly thickened towards apex, the joints transverse, the club subulate; head transverse, the vertex subacute, the temples flat and very narrow.
   Endomychobius Ashmead (type *E. flavipes* Ashm.).
15. Metathoracic spiracles oval 16
   Metathoracic spiracles small, rounded.
      Metanotum *without* a median carina; abdomen conic-ovate, beneath subconvex, the second segment occupying about one third the whole surface, segments 3–6 subequal, the 7th the longest, the 8th conical; flagellum filiform, or at the most subclavate; marginal vein long, slightly thickened . . . . **Scymnophagus** Ashmead, g. nov. (type *S. townsendi* Ashm.).
16. Metathorax very short, smooth, impunctate, with a median carina; scutellum convexly rounded; abdomen short, ovate, not longer than the thorax, boat-shape beneath, the second segment occupying one third the surface, the following short, subequal.
   Epipteromalus Ashmead, g. nov. (type *E. algonquinensis* Ashm.).
17. First two ring-joints minute, equal, smaller than the third; funicle joints wider than long; metathorax not short, the lateral folds incomplete, the spiracles oval; abdomen ovate, as long as the head and thorax united.
18. Abdomen ovate, not longer than the head and thorax united, usually a little shorter, the apical margins of the segments straight, not incised or emarginate 19
   Abdomen conic-ovate, often carinate beneath, and usually a little longer than the head and thorax united, the second segment the longest, the third usually the shortest, both sometimes, but not always, with a slight incision or emargination at apical middle; segments 4–6 most frequently increasing in length, the eighth conical; sometimes segments 2–5 are subequal 20

19. Second abdominal segment about twice as long as the third or a little longer, segments 3–5 subequal, 6 and 7 longer; venter subconvex or convex. **Pteromalus** Swederus (type *Ichneumon puparum* Linné).
Second abdominal segment about three times as long as the third, segments 4 and 5 united not longer than the third, those beyond variable, subequal in length; venter usually strongly compressed or keeled .... **Hypopteromalus** Ashmead, g. nov. (type *Pteromalus tabacum* Fitch).
20. Marginal vein longer than the stigmal; metathoracic spiracles usually oblong-oval, close to the post-scutellar fold; funicle joints longer than thick, usually about twice as long as thick or nearly; abdomen not strongly carinate beneath towards base. .... **Catolaccus** Thomson (type *C. cavigena* Thoms.).
Marginal vein only a little longer than the stigmal; metathoracic spiracles small, short oval or sub-rotund; funicle joints very little longer than thick; abdomen strongly carinate beneath towards base .... (?) **Norbanus** Walker (type *N. dysaulus* Walk.).
21. Postmarginal vein *longer* than the stigmal vein, but rarely a great deal longer 22
Postmarginal vein *shorter* than the stigmal vein, or of an equal length; pedicel small, usually much shorter than the first joint of the funicle; in a single case only is it much longer 27
22. Antennæ with *three* ring-joints.. 23
Antennæ with *two* ring-joints.. 24
23. Metanotum very short, with a median carina and lateral folds, the latter intersected by a transverse carina or fold that extends on each side from the median carina; spiracles large, oblong; abdomen conic-ovate and somewhat produced at apex............................ **Neocatolaccus** Ashmead. (type *Catolaccus tylodermæ* Ashm.).
24. Pedicel *shorter* than the first joint of the funicle.. 25
Pedicel *longer* than the first joint of the funicle 26
25. Metanotum with a median carina and lateral folds, the spiracles usually large, long oval or linear; abdomen conic-ovate, keeled beneath; postmarginal vein not or only a little longer than the stigmal. **Metapachia** Westwood (type *M. dispar* Westw.).
Metanotum with a median carina, the lateral folds wanting, the spiracles oval, not large; abdomen ovate, subcompressed beneath; postmarginal vein very long.... **Parapteromalus** Ashmead, g. nov. (type *P. isosomatis* Ashm.).
26. Metanotum usually with a distinct median carina, the lateral folds incomplete, indicated toward the base, the spiracles oval or elliptic.
Abdomen conic-ovate..................... **Hypopteromalus** Ashmead (type *P. tabacum* Fitch).
Abdomen rotund........................ **Diglochis** Förster (type *Pteromalus omnivorus* Walk.).
27. Head wide, but the temples and cheeks rounded, not especially broad; pedicel shorter than the first joint of the funicle. 28
Head large, broad, the temples and the cheeks broad, acute; pedicel long, much longer than the first joint of the funicle.
Antennæ inserted just above the clypeus; abdomen rotund, wider than the thorax, rarely ovate. **Cœlopisthia** Förster (type *Pteromalus cephalotes* Walk.).
28. Antennæ inserted on or very near the middle of the face, never far below the middle............. 29
Antennæ inserted far below the middle of the face.
Metathorax not very short; abdomen ovate or conic-ovate, usually convex beneath. **Dibrachys** Förster (type *Pteromalus boucheanus* Ratz.).
29. Abdomen conic-ovate, not much produced beneath, if at all .... **Arthrolytus** Thomson. (type *A. punctatus* Thoms.).
Abdomen conic-ovate, but beneath towards base, acutely triangularly produced. **Metapachia** Westw. (partim).

30. Occipital foraminal depression distinctly margined or rimmed.................................... 31
Occipital foraminal depression simple, immargined.. 37

31. Metathorax at apex produced into a subglobose neck, the median carina and the lateral folds usually present.
Antennæ with *two* ring-joints.. 32
Antennæ with *three* ring-joints..**Belonura** Ashmead.

32. Eyes hairy.. 33
Eyes bare, not hairy.. 36

33. Postmarginal vein longer than the stigmal... 34
Postmarginal vein *not* longer than the stigmal, usually a little shorter.......................... 35

34. Second abdominal segment very large..**Isocyrtus** Walker.
Second abdominal segment normal; flagellum subclavate, pubescent, the joints transverse or quadrate.
Urolepis Walker.

35. Flagellum subclavate or clavate, clothed with a short pubescence, the joints usually much wider than long; tibiæ with rigid bristles; abdomen rotund, the second segment not especially large.
Trichoglenes Thomson.

36. Antennæ filiform, pubescent; funicle joints 4 to 6 usually a little wider than long or not longer than wide..**Trichomalus** Thomson.

37. Metathorax at apex usually produced into a subglobose neck; postmarginal vein always longer than the stigmal.. 38
Metathorax at apex normal; postmarginal vein rarely longer than the stigmal, most frequently shorter or of an equal length.. 46

38. Legs normal, the middle tibiæ not dilated.. 39
Legs abnormal, the middle tibiæ dilated toward tips; antennæ with the joints alternately white and brown..**Polyscelis** Thomson.

39. Pedicel long, always longer than the first joint of the funicle.............................. 40
Pedicel short, never longer than the first joint of the funicle, usually much shorter, the first joint of the funicle the longest of the funicle joints.. 41

40. Metathoracic spiracles small, elliptic; abdomen short oval, depressed; flagellum filiform, pilose, the joints cup-shaped, transverse......................................**Endomychobius** Ashmead.
Metathoracic spiracles oval; abdomen boat-shaped; flagellum subfiliform or subclavate, pubescent, the club always longer and stouter than the pedicel...............**Meraporus** Walker.

41. Antennæ with *two* ring-joints... 42
Antennæ with *three* ring-joints?

42. Metathoracic spiracles small, rounded.. 43
Metathoracic spiracles not small, rounded.. 44

43. Antennæ subclavate, pubescent; abdomen oblong-oval, flat, beneath at the most convex.
Scymnophagus Ashmead.

44. Metathoracic spiracles long oval or oblong, more rarely subreniform or linear.................. 45
Metathoracic spiracles smaller, oval or broadly oval.
Metanotum very short, smooth, impunctate with a median carina......**Epipteromalus** Ashmead.

45. Metathoracic spiracles long-oval or oblong.
Abdomen oblong-oval, dorsal segments 3–5 unequal, gradually increasing in length, united a little longer than the second; flagellum filiform, pubescent, the joints of the funicle about twice as long as thick or longer...**Pteromalus** Swederus.

Metathoracic spiracles oblong, linear or subreniform.

Abdomen oblong, at least $2\frac{1}{2}$ times as long as wide, dorsal segments 3–6 subequal; flagellum filiform, the joints of the funicle longer than thick. .... **Catolaccus** Thomson.

46. Postmarginal vein longer than the stigmal 47

Postmarginal vein shorter than the stigmal or no longer 49

47. Antennæ with *two* ring-joints.. 48

Antennæ with *three* ring-joints.

Metathorax short with a median carina and lateral folds, the latter intersected by a transverse carina which extends from the short median carina; the spiracles large, oblong.
Neocatolaccus Ashmead.

48. Metathorax *with* a distinct median carina, the lateral folds incomplete, the spiracles usually oval; head large, broad, the vertex broad. .... **Diglochis** Förster.

Metathorax *without* a median carina, the lateral folds absent, the spiracles oval or ovate, not large; head transverse, not large, the temples flat .... **Parapteromalus** Ashmead.

49. Antennæ inserted on or near the middle of the face, or far above the clypeus 50

Antennæ inserted far below the middle of the face or just above the clypeus.

Head large, broad, the temples broad, acute; metathorax short, the lateral folds absent; abdomen very short, rounded, depressed.................................. **Cœlopisthia** Förster.

Head large, broad, but the temples rounded, not acute; metathorax not very short, the lateral folds complete; abdomen oblong-oval, depressed .... **Dibrachys** Förster.

50. Antennæ subclavate, pubescent, the club much stouter than the funicle, the pedicel much longer than the first joint of the funicle. .... **Metapachia** Westwood.

Antennæ filiform, pubescent or pilose, the pedicel much shorter than the first joint of the funicle; funicle joints 1–4 distinctly longer than thick. .... **Arthrolytus** Thomson.

Subfamily II. Merisinæ.

The absence of the spiracular sulci, an important character, alone distinguishes this tribe; otherwise it closely resembles the subfamily *Pteromalinæ*, its relationship being quite close through the tribe *Eutelini*, with the gall-inhabiting species in the tribe *Merisini*.

I have recognized three tribes; the first being parasites of Coleoptera, the second of Diptera, while the third attack Rhynchota belonging to the homopterous families *Aphididæ*, *Aleurodidæ* and *Coccidæ*.

TABLE OF TRIBES.

1. Metanotum *without* a trace of a median carina.. 2

Metanotum *with* the median carina more or less distinct or at least indicated basally; mesonotum with incomplete furrows .... Tribe I. Roptrocerini.

2. Mesonotum with *incomplete* furrows.................................. Tribe II. Merisini.

Mesonotum with *complete* furrows .... Tribe III. Isoplatini.

Tribe I. *Roptrocerini.*

This tribe is distinguished by the metanotum, which always has a more or less distinct median carina; or at least it is never wholly absent as in the *Merisini* and the *Isoplatini*.

TABLE OF GENERA.

1. Females 2
   Males 5
2. Ovipositor strongly exserted; marginal vein about twice as long as the stigmal vein or even longer; antennæ with *two* ring-joints 3
   Ovipositor not exserted, at the most with only the tip of the sheaths exposed 4
3. Antennæ 13-jointed, inserted just above the clypeus; scape not attaining the ocelli; funicle joints 2–6 transverse, the club not stout, rounded at tip .... **Anogmus** Förster (type *A. strobilorum* Thoms.).
   Antennæ 13-jointed, inserted on the middle of the face or nearly, the flagellum stout, subclavate; funicle joints 3–6 stout, transverse, the club very stout, oblong .... **Roptrocerus** Ratzeburg. (type *R. xylophagarum* Ratz.).
4. Antennæ with *two* ring-joints; abdomen conic-ovate, pointed at tip.
   Abdomen longer than head and thorax united, carinate beneath, the third segment the shortest, segments 4 and 5 increasing in length, the sixth a little shorter than the fifth, seventh and eighth subequal, about as long as the fourth, the eighth conical with the spiracles distinct; sheaths of ovipositor slightly projecting. .... **Uriella** Ashmead (type *U. rufipes* Ashm.).
   Abdomen, as seen from above, conic-ovate, beneath compressed and strongly, triangularly carinate, as long as the thorax, segments 2–4 about equal, united not longer than the first, metathorax very short, smooth, but with a median carina, the spiracles rounded.
   Tropidogastra Ashmead, g. nov. (type *T. arizonensis* Ashm.).
5. Antennæ 13-jointed, with *two* ring-joints, inserted on or near the middle of the face 6
   Antennæ 13-jointed, with *two* ring-joints, inserted just above the clypeus .... **Anogmus** Förster.
6. Metathoracic spiracles small, rounded; flagellum long, filiform; abdomen oblong-oval, fully as long as the thorax; marginal vein slender, longer than the stigmal vein .... **Roptrocerus** Ratzeburg.
   Metathoracic spiracles large, oval; flagellum shorter, subclavate; abdomen oblong-oval, a little longer than the thorax, subcarinate beneath towards base; marginal vein stout and not longer than the stigmal vein with its knob .... **Uriella** Ashmead.

TRIBE II. *Merisini.*

This tribe is at once separated from the *Isoplatini* by having *incomplete*, never complete, mesonotal furrows, the furrows at the most being indicated only anteriorly.

TABLE OF GENERA.

1. Females 2
   Males 5
2. Metathorax not terminating in a subglobose neck 3
   Metathorax terminating in a subglobose neck.
   First joint of the funicle short, much shorter than the pedicel; abdomen subovate or subrotund, the second segment (first body) occupying fully one half or more of the whole surface.
   Micromelus Walker (type *M. rufomaculatus* Walk.).
3. Marginal vein not or hardly longer than the stigmal vein, the front wings often with a submarginal or discoidal cloud 4
   Marginal vein distinctly longer than the stigmal vein, the front wings without a submarginal or discoidal cloud.
   Abdomen longer than the thorax and ending in a short or subexserted ovipositor.
   Phænacra Förster.

Abdomen ovate, not longer than the thorax, the ovipositor not exserted, the second segment (first body) occupying about one fourth the whole surface, the third segment small.
Merisus Walker (type *M. splendidus* Walk.).

4. Abdomen ovate, the dorsum usually flat, the second segment not occupying one fourth the whole surface, segments 3–6 subequal............**Homoporus** Thomson (type *Pteromalus fulviventris* Walk.).
5. Metathorax not ending in a subglobose neck.. 6
Metathorax ending in a subglobose neck.
Abdomen subrotund or short ovate, the second segment large, occupying one half or more of the whole surface; antennæ filiform, clothed with a short, fine pubescence.
Micromelus Walker.
6. Marginal vein always distinctly longer than the stigmal vein.................................. 7
Marginal vein *not* or scarcely longer than the stigmal vein.. 8
7. Antennæ at apex stylate; abdomen oval, depressed..........................**Phænacra** Förster.
Antennæ at apex normal; abdomen oblong, narrowed, the second segment not quite as long as the three following united, which are short and subequal, the fourth very slightly the longest; antennæ filiform, rather densely pubescent..**Merisus** Walker.
8. Abdomen short, spatulate, the second segment as long as or a little longer than the three following united, which are very short, the third the longest; antennæ filiform, densely pubescent.
Homoporus Thomson.

Tribe III. *Isoplatini.*

In this tribe the mesonotal furrows are always distinct, complete, while the antennæ are usually inserted far anteriorly near the mouth border.

TABLE OF GENERA.

1. Females. 2
Males... 5
2. Non-metallic; mandibles variable, sometimes edentate.. 3
Metallic; mandibles dentate.
Abdomen compressed, the ventral valve prominent; stigmal vein as long as the marginal, ending in a small knob..........................**Isoplata** Förster (type *I. geniculata* Först.).
3. Mandibles acute, edentate.. 4
Mandibles broad, dentate.
Abdomen conic-ovate; antennæ short, strongly clavate, inserted near the mouth border, the pedicel large; stigmal vein as long as the marginal, clavate.
Cœlocyba Ashmead (type *C. nigrocincta* Ashm.).
4. Abdomen short, globose, depressed above; marginal vein not or scarcely longer than the stigmal vein; metathorax very short.
Stigmal vein ending in a small knob; abdomen with the first dorsal segment elongate, occupying half or more of the whole surface.........**Terobiella** Ashmead (type *T. flavifrons* Ashm.).
Stigmal vein ending in a moderately large knob; abdomen with the dorsal segments short.
Brachyscelidiphaga Ashmead (type *B. flava* Ashm.).
5. Non-metallic; mandibles acute or broad, dentate.. 6
Metallic; mandibles dentate..**Isoplata** Förster.
6. Mandibles acute, edentate.. 7
Mandibles broad, dentate.

Antennæ short, clavate, inserted close to the mouth border; stigmal vein long, clavate. **Cœlocyba** Ashmead.

7. Stigmal vein ending in a small knob. .... **Terobiella** Ashmead.

Stigmal vein ending in a moderately large knob. .... **Brachyscelidiphaga** Ashmead.

SUBFAMILY III. EUNOTINÆ.

1863. Muscidides Motschulsky, Bull. Soc. Imp. Nat., XXXVI, 1863 (2), p. 69.

1872. Family? Walker, Notes on Chalc., VI., p. 100.

1898. Muscideinæ, Subfam. dubia, Dalla Torre, Cat. Hym., V, p. 87.

This small subfamily comprises a number of genera, all evidently of tropical origin, and all parasites of the rhynchotous family *Coccidæ.*

The first genus to be described was *Eunotus* Walker, in 1834. It was later named *Trityphus* by Ratzeburg, and again rechristened *Megapelte* by Förster.

In 1863 Motschulsky described, briefly, poorly, and sometimes inaccurately, several new genera from Ceylon, which belong here, and proposed for the group the name *Muscidides,* stating that "Ils se distinguent des Pteromalides par leur forme plus raccourcie et plus large, qui rappelle celle des Chalcidides et par leur mésonotum, qui prend quelquefois une telle extensione, qu'il recouvre tout l'abdomen, comme ches les Scutellaires parmi Hémiptères, ce qui fait replier les ailes horisontalement sous ce mésonotum d'une manière analogue. Les ailes sont pubescent comme chez les Pteromalides."

The genus *Eunotus* Walker, was described twenty years before *Muscidea* Motschulsky, and I prefer to call the group *Eunotinæ,* after the first described genus, in accordance with the rules of zoölogical nomenclature, rather than the *Muscideinæ,* the term *Muscidides* not being tenable.

Cephaleta Motschulsky, if I have identified it correctly, belongs here, but Motschulsky correlated with it a male insect with *branched* antennæ, which, from the description and the poor figure, I think is a Eulophid, and probably identical with *Pentacladia* Westwood, described in 1835.

TABLE OF GENERA.

1. Females. 2

Males 12

2. Scutellum large, but not extending beyond the base of the abdomen 3

Scutellum abnormally large, extending over most of the abdomen.

Head very wide, lenticular, wider than the thorax; antennæ 8 or 9-jointed, the flagellum clavate. .... **Scutellista** Motschulsky (type *S. cyanea* Motsch.).

3. Second dorsal abdominal segment much shorter, at the most occupying only a little more than half the whole surface of the abdomen 5

Second dorsal abdominal segment long, occupying nearly the whole surface of the abdomen; eyes pubescent.

Antennæ 9-jointed; scutellum twice the length of the mesonotum.

Euargopelte Förster (type *E. obscura* Först.).

Antennæ 10-jointed; scutellum not twice the length of the mesonotum.

Eunotus Walker (type *E. cretaceus* Walk.).

5. Postmarginal vein rather short, not longer than the stigmal vein, sometimes shorter 6

Postmarginal vein not short, always longer than the stigmal vein.

Antennæ 9-jointed or less 8

Antennæ 10-jointed, the joints large, depressed, and narrowed toward apex; body greenish metallic, punctate .... **Mnoonema** Motschulsky (type *M. timida* Motsch.).

6. Antennæ 7-jointed or less 7

Antennæ 8-jointed, clavate, funicle joints 2–4 transverse.

Muscidea Motschulsky (type *M. pubescens* Motsch.).

7. Antennæ 7-jointed, subclavate, the last joint large, oval, joints 2–4 not transverse.

Cardiogaster Motschulsky (type *C. fusciventris* Motsch.).

Antennæ 6-jointed, filiform, depressed, joints 3–5 nearly equal, the sixth a little longer, acuminate at apex .... **Solenoderus** Motschulsky (type *S. cyaniventris* Motsch.).

8. Antennæ 9-jointed, or less 9

Antennæ 10-jointed .... **Anysis** Howard (type *H. australiensis* How.).

9. Antennæ 8-jointed or less 10

Antennæ 9-jointed .... ? genus.

10. Antennæ 7-jointed 11

Antennæ 8-jointed .... **Eurycranium** Ashmead * (type *E. alcocki* Ashm.).

11. Antennæ 7-jointed .... **Cephaleta** Motschulsky (type *C. purpuriventris* Motsch.).

12. Scutellum not extending beyond the base of the abdomen 13

Scutellum abnormally large, covering most of the abdomen .... **Scutellista** Motschulsky.

13. Abdomen with the second dorsal segment shorter, not nearly occupying the whole of the surface . . 14

Abdomen with the second segment large, occupying nearly the whole surface; eyes pubescent.

Antennæ 10-jointed .... **Eunotus** Walker.

Antennæ 9-jointed .... **Euargopelte** Förster.

14. Postmarginal vein well developed, always longer than the stigmal 15

Postmarginal vein not well developed, not longer than the stigmal, sometimes shorter 17

15. Antennæ 9-jointed or less 16

Antennæ 10-jointed .... **Mnoonema** Motschulsky.

16. Antennæ 8-jointed or less 7

Antennæ 9-jointed, filiform .... **Muscidea** Motschulsky.

17. Antennæ 8-jointed .... **Cardiogaster** Motschulsky.

Antennæ 7-jointed .... **Solenoderus** Motschulsky.

18. Antennæ 9-jointed.

Lateral ocelli almost touching the eye margin .... **Anysis** Howard.

Lateral ocelli twice their width from the eye margin .... **Eurycranium** Ashmead.

Antennæ (?) 7-jointed, with 5 branches.

Cephaleta Motsch. (partim) ? = *Pentacladia* Westw., a Eulophid.

* Equals *Eurycephalus* Ashm., Indian Mus. Notes, V., 1903, p. 61, preoccupied.

SUBFAMILY IV. SPHEGIGASTERINÆ.

1856. Miscogasteroidæ, Familie 14 (partim), Förster, Hym. Stud., II., p. 24.
1856. Miscogastroidæ, Familie 14 (partim), *opus cit.*, p. 51.
1875. Sphegigastrides, Subtribus (partim), Thomson, Hym. Skand., IV., p. 217.
1875. Caratomides, Subtribus, Thomson, *opus cit.*, p. 216.
1887. Pteromalinæ, Subfamily (partim), Howard, Ent. Amer., II., pp. 33 and 35.
1897. Sphegigasterinæ, Subfamily III., Ashmead, Proc. Ent. Soc. Washington, IV., p. 248.
1898. Chrysolampinæ, Subfamily, Dalla Torre, Cat. Hym., V., p. 16.

This subfamily is distinguished from the three preceding subfamilies by the distinctly petiolated abdomen, and from the two which are to follow, which also have the abdomen petiolate, by other characters; from the *Spalangiinæ* by having a totally different shaped head, and by the venation; from the *Diparinæ* by thoracic and antennal characters.

Four very distinct minor groups, here called tribes, have been recognized.

TABLE OF TRIBES.

1.	Antennæ inserted near the mouth border or just above the clypeus	2
	Antennæ inserted on or near the middle of the face, *far* above the clypeus	3
2.	Head usually lenticular, much wider than the thorax, deeply concave behind, rarely normal; parapsidal furrows complete	Tribe I. Asaphini.
3.	Front wings with a slender marginal vein	4
	Front wings with a thick, stout, usually short marginal vein	Tribe II. Pachyneurini.
4.	Head transverse, the temples not very broad	Tribe III. Sphegigasterini.
	Head very large, the temples very broad, the frons sometimes cornuted	Tribe IV. Cratomini.

TRIBE I. *Asaphini.*

This tribe is readily distinguished from the others in the subfamily by the antennæ being inserted near the mouth border, or just above the clypeus; they are never inserted near the middle of the face.

It is based upon the genus *Asaphes* Walker, which was rechristened *Isocratus* by Dr. Förster, and placed by him in the subfamily *Spalangiinæ*, with which group it has nothing in common.

The habits of the genera falling in this tribe are fairly uniform, the vast majority of the species being parasites upon plant-lice, *Aphididæ*, and upon the bark-lice, *Coccidæ*.

TABLE OF GENERA.

1.	Females	2
	Males	10

2. Head very wide, the occiput strongly concave 3
   Head not especially wide, the occiput not strongly concave 6
3. Winged 4
   Wingless or subapterous.
      Antennæ strongly clavate, 9-jointed, ending in a large, solid ovate club, the scape dilated at apex; funicle 6-jointed, joints 2–6 transverse, the sixth about four times as wide as long; metathorax very short, without carinæ, the spiracles small, rounded; abdomen oval, the petiole scarcely longer than thick, the third segment (second body segment) a little longer than the second .... **Pheidoloxenus** Ashmead, g. nov. (type *P. wheeleri* Ashm.).
4. Antennæ 10-jointed 5
   Antennæ 13-jointed 9
5. Abdomen with the second segment abnormally large, occupying most of the surface.
      Marginal vein scarcely longer than the stigmal vein, the postmarginal vein wanting; body of abdomen with a tuft of hairs on each side at base.
      Tomocera Howard (type *T. californica* How.).
      Marginal vein fully twice as long as the stigmal vein, the postmarginal vein distinct, about the length of the stigmal; no tuft of hairs at base of abdomen.
      Ophelosia Riley (type *O. crawfordi* Riley).
6. Marginal vein about three times as long as the stigmal vein or a little longer 7
   Marginal vein short, at the most scarcely twice as long as the stigmal vein, usually shorter 8
7. Antennæ 10-jointed, the second joint of the funicle twice as long as the first; scutellum *with* a cross-furrow before the apex .... **Aphobetus** Howard (type *A. maskelli* How.).
   Antennæ 13-jointed 9
8. Marginal vein hardly twice as long as the stigmal vein, the postmarginal vein very short; antennæ 10-jointed, the joints of the funicle short, submoniliform; scutellum *without* a cross-furrow before the apex .... **Aphobetoideus** Ashmead, g. nov. (type *A. comperei* Ashm.).
   Marginal vein hardly as long as the stigmal vein, the postmarginal vein long; antennæ 13-jointed, with 2 ring-joints .... **Asaphes** Walker (type *A. vulgaris* Walk.).
9. Marginal vein about thrice as long as the stigmal vein.
   Parasaphes Ashmead, g. nov. (type *P. iceryæ* Ashm.).
10. Antennæ 9 or 10-jointed; head usually wide 11
    Antennæ 13-jointed; head normal 14
11. Postmarginal vein wanting or very short 12
    Postmarginal vein distinct, about the length of the stigmal vein.
       Marginal vein twice as long as the stigmal; no tuft of hairs at base of scutellum.
       Ophelosia Riley.
12. Marginal vein long, about twice as long as the stigmal or even thrice as long 13
    Marginal vein short, hardly as long as the stigmal.
       Abdomen with a tuft of hairs on each side at base; antennæ dentate .... **Tomocera** Howard.
13. Antennæ 9-jointed.
       Scutellum *without* a cross-furrow before apex .... **Aphobetus** Howard.
       Scutellum *with* a cross-furrow before apex .... **Aphobetoideus** Ashmead.
14. Marginal vein scarcely as long as the stigmal vein, a little thickened at base, the postmarginal vein long .... **Asaphes** Walker.
    Marginal vein about thrice as long as the stigmal vein .... **Parasaphes** Ashmead.

Tribe II. *Pachyneurini.*

In this tribe the antennæ are inserted near the middle of the face, and the marginal vein in the front wings is always *thickened* and usually short.

The species, like the *Asaphini* are said to be parasites of coccids and aphids, but these insects have other hymenopterous parasites, braconids, encyrtids, cynipids, etc., and the *Pachyneurini* are probably hyperparasites of these insects.

A few have also been bred from dipterous insects belonging to the family *Syrphidæ*, which also have other hymenopterous parasites, and this seems to confirm the hyperparasitism of these insects.

TABLE OF GENERA.

1. Females.. 2
   Males.. 7
2. Mesothoracic furrows distinct, complete.. 3
   Mesothoracic furrows incomplete, indicated only anteriorly.. 4
3. Stigmal vein with a large knob; abdomen ovate, pointed at apex, the second segment large, the third segment very short, the fourth and fifth rather large, subequal, the following very short.
   Pachycrepis Förster (type *Caruna clavata* Walk.).
   Stigmal vein with a small knob; abdomen ovate, the second and the third segments large, the fourth and fifth very short, the sixth and seventh longer.
   Pachycrepoideus Ashmead, g. nov. (type *P. dubius* Ashm.).
4. Abdomen above flat or depressed.. 5
   Abdomen above convexly rounded.. 6
5. Pronotum much narrower than the mesonotum across the shoulders; abdomen oval or short ovate, the second segment the longest, occupying a good portion of the surface, the third and fourth short, nearly equal, the following very short.....................**Pachyneuron** Walker (type *P. formosum* Walk.).
   Pronotum as wide as the mesonotum across the shoulders; scutellum with a cross-furrow just before the apex; abdomen seen from above ovate, nearly as long as the head and thorax united, beneath compressed or keeled, the ventral valve prominent, plowshare-shaped, the second segment fully twice as long as the third, or longer, the fourth a little longer than the third, the following subequal, the sixth as long or a little longer than the fifth...................**Euneura** Walker (type *E. augarus* Walk.).
6. Pronotum narrower than the mesothorax; scutellum without a cross-furrow before apex; abdomen ovate, the second segment the longest, the third, fourth and fifth not short, subequal, the fourth a little the longest, the sixth about one third shorter than the fifth.
   Hypsicamera Förster (type *H. ratzeburgii* Reinhard).
7. Mesothoracic furrows incomplete, indicated only anteriorly.. 8
   Mesothoracic furrows complete.
   Stigmal club large...**Pachycrepis** Förster.
   Stigmal club small...**Pachycrepoideus** Ashmead.
8. Pronotum as wide as the mesonotum; scutellum with a cross-furrow before the apex. **Euneura** Walker.
   Pronotum narrower than the mesonotum; scutellum without a cross-furrow before apex.
   Metanotum rather short; funicle joints not more than twice as long as thick.
   Pachyneuron Walker.
   Metanotum long; funicle joints thrice as long as thick................**Hypsicamera** Förster.

TRIBE III. *Sphegigasterini.*

The species falling in this tribe are easily recognized by the much longer and more slender marginal vein. They differ from the others also in habits, the majority of the species being parasites of dipterous insects, and especially of the gall-making species belonging principally to the family *Cecidomyiidæ.*

TABLE OF GENERA.

1. Females.. 2
   Males.. 16
2. Abdominal petiole longer than the hind coxæ.. 3
   Abdominal petiole shorter than the hind coxæ, or at least never longer.......................... 7
3. Head with the cheeks compressed, the vertex not very narrow..................................... 4
   Head sublenticular, the cheeks rounded, the vertex narrow.
   Pronotum large, quadrate, mesonotum flat, with complete parapsidal furrows; second abdominal segment very large, occupying fully two thirds of the whole surface of the abdomen, the following very short .... **Syntomopus** Walker (type *S. thoracicus* Walk.).
4. Mesothoracic furrows incomplete, abbreviated posteriorly or only distinct anteriorly.............. 5
   Mesothoracic furrows complete, distinct.
   Scutellum *with* a cross-furrow before the apex; abdomen short oval, keeled beneath, the second and third segments very large, the second broadly emarginate at apical margin.
   Merismus Walker (type *M. megapterus* Walk.).
   Scutellum convex, *without* a cross-furrow before the apex, the second segment large, occupying a little more than half the whole surface of the abdomen, the apical margin straight, not emarginate................................ **Acroclisis** Förster (type *A. nigricornis* Först.).
5. Metanotum usually smooth, but always *with* a median carina (except sometimes in *Polycyrtus*), the lateral folds also usually present... 6
   Metanotum punctate, *without* either a median carina or lateral folds.
   Scutellum convex, *without* a cross-furrow before the apex; abdomen with the second and third segments very large; sometimes the abdomen is triangulate as in *Perilampus.*
   Trigonogastra Ashmead, g. nov. (type *T. aurata* Ashm.).
6. Scutellum *with* a delicate cross-furrow before the apex; abdomen with the second and third segments very large, the latter about one third the length of the second................ **Sphegigaster** Spinola (type *S. pallicornis* Spin.).
   Scutellum *without* a cross-furrow before the apex or the furrow is subabsolute; abdomen with the second segment very large, occupying half or a little more than half the whole surface, the following very short, often retracted. .... **Cryptoprymna** Förster (type *Prosodes atra* Walker).
7. Mesothoracic furrows incomplete, much abbreviated, or indicated only anteriorly.................. 8
   Mesothoracic furrows complete, distinct, rarely only two thirds the length of the mesonotum...... 13
8. Metanotum not broad, and *with* a more or less distinct median carina, or at least the carina is indicated basally... 9
   Metanotum broad, punctate, *without* a median carina.................................. ? genus.
9. Second abdominal segment at apex broadly and usually deeply, semicircularly emarginate........ 10
   Second abdominal segment at apex not broadly and deeply emarginate, straight or at the most with only a slight sinus.. 11

10. Abdomen ovate, the second and third segments very large, occupying the larger part of the surface.
Cyrtogaster Walker (type *C. vulgaris* Walker).

11. Metanotum punctate, with an abbreviated median carina.. 12
Metanotum smooth, impunctate, but with a distinct median carina.
Pronotum anteriorly not acute; axillæ separated at base of scutellum; abdomen ovate or conic-ovate, the second segment large, occupying about half the whole surface.
Polycystus Westwood (type *P. matthewsii* Westw.).
Pronotum anteriorly acute; axillæ meet at base of scutellum; abdomen triangulated, much as in *Perilampus*, the second segment large............................ **Trigonogastra** Ashmead.

12. Abdomen short, ovate, wider than the thorax, but a little shorter, the second segment twice the length of the third, the apical margin entire, the following segments gradually shortening.
Eurydinota Förster (type *E. leptomera* Förster).

13. Abdomen with the second segment occupying fully one third the whole surface, 3 to 5 subequal in length, the sixth longer than the fifth, the two following very short.
Pterosema Förster (type *P. variicolor* Först.).

14. Metanotum not closely punctate and tricarinate.. 15
Metanotum not long, and smooth, the median carina and lateral folds usually present.
Middle tibiæ normal; abdomen ovate, pointed at apex, the petiole shagreened, with a median ridge, the second segment the largest, occupying about half the whole surface, with a slight incision at apex.. **Polycystus** Westwood.
Middle tibiæ abnormal, incrassate; abdomen short ovate.................. **Spaniopus** Walker (type *S. dissimilis* Walk.).

15. Abdomen conic-ovate, the petiole rugulose, the second segment occupying at the most one third the whole surface, the following segments subequal, less than half the length of the second; pronotum not short............................**Bubekia** Dalla Torre (type *Brachycrepis tricarinata* Ashm.).

16. Petiole of abdomen long, always longer than the hind coxæ.................................... 17
Petiole of abdomen shorter, not longer than the hind coxæ...................................... 29

17. Mesothoracic furrows complete.. 18
Mesothoracic furrows incomplete, indicated only anteriorly..................................... 21

18. Head with compressed cheeks; pronotum not large, not transverse quadrate..................... 19
Head sublenticular, with rounded cheeks, the vertex antero-posteriorly narrow; antennæ filiform, pubescent.. **Syntomopus** Walker.

19. Scutellum with a cross-furrow before apex.. 20
Scutellum without a cross-furrow before apex... 28

20. Abdomen with dorsal segments 2 and 3 large, the second twice the length of the third and deeply, broadly, semicircularly emarginate at apex; flagellum subclavate, pubescent... **Merismus** Walker.
Abdomen ovate, the second dorsal segment large, occupying more than half the whole surface, not emarginate at apex.. **Acroclisis** Förster.

21. Metanotum usually smooth, with lateral folds and a median carina; both mandibles 4-dentate..... 24
Metanotum closely punctate and often, but not always, without lateral folds or a median carina, rarely distinct.. 22

22. Abdomen not triangular, either oval or oblong-oval.. 23
Abdomen triangular; mandibles 4-dentate, the outer tooth acute; pronotum anteriorly truncate, the upper front margin acute.. **Trigonogastra** Ashmead.

23. Metathorax not long, but produced into a subglobose neck at apex; both mandibles 3-dentate.... 24

Metathorax long and also produced into a subglobose neck at apex ; pronotum with the front margin rounded ; both mandibles 4-dentate .... **Bubekia** Dalla Torre.

24. Palpi normal 25
    Palpi abnormal 26
25. Middle tibiæ abnormal, incrassated at apex 27
    Middle tibiæ normal.
    Abdomen with dorsal segments 2 and 3 large .... **Sphegigaster** Spinola.
26. Abdomen with the second segment large, occupying most of the surface, its apical margin not incised. **Cryptoprymna** Förster.
    Abdomen with the second segment not so large, its apical margin usually with a slight incision ; antennæ, except the club, usually yellow .... **Polycyrtus** Westwood.
27. Abdomen short, the second segment at apex not incised .... **Spaniopus** Walker.
28. Antennæ filiform .... ? g. nov.
29. Mesothoracic furrows incomplete or indicated only anteriorly 30
    Mesothoracic furrows complete 33
30. Metanotum smooth or at the most feebly punctate 31
    Metanotum punctate or sculptured, opaque.
    Abdomen triangular ; pronotum anteriorly truncate, the upper margin acute. **Trigonogastra** Ashmead.
    Abdomen oblong-oval ; pronotum anteriorly rounded, the upper margin not acute. **Bubekia** Dalla Torre.
31. Second dorsal abdominal segment at apex, *not* broadly, deeply semicircularly emarginate, either straight or with only a slight incision 32
    Second dorsal abdominal segment at apex broadly and deeply semicircularly emarginate. **Cyrtogaster** Walker.
32. Head wide but not thick ; antennæ subfiliform, the second ring-joint larger than the first, the scape slender, but hardly reaching to the front ocellus, the funicle joints not longer than thick. **Polycyrtus** Westwood.
    Head large and thick, much wider than the thorax ; antennæ clavate, the ring-joints equal, annular, the scape long and slender .... **Tityros** Walker (type *T. pareia* Walk.).
33. Metanotum with one or three carinæ 34
    Metanotum broad, *without* a median carina.
    Abdomen with the second segment occupying fully one third the whole surface. **Pterosema** Förster.
34. Metanotum with the lateral carinæ or folds wanting, the median carina present, usually abbreviated. **Eurydinota** Förster.
    Metanotum long, closely punctate, tricarinate .... **Bubekia** Dalla Torre.

TRIBE IV. *Cratomini.*

1875. Caratomides, Subtribus, Thomson, Hym. Skand., IV., p. 216.

1878. Caratomides, Subtribus, Thomson, *opus cit.*, V., p. 44.

This group is based upon the genus *Cratomus* Dalman, established in 1820. Later the genus was changed to *Caratomus.* I have however, retained the original spelling and shall call the group *Cratomini.*

Haliday thought *Cratomus* was allied to the *Perilampidæ* and placed it in that family, an unnatural position for it. It is a true *Pteromalid* and falls into the subfamily *Sphegigasterinæ*, as is abundantly proved by the discovery of my genus *Paracaratomus.*

Nothing is positively known of the habits of this minor group, but I suspect that the group is parasitic upon the larvæ of beetles.

TABLE OF GENERA.

Head cornuted in front; face with converging striæ below the insertion of the antennæ; abdomen short, subsessile or briefly petiolate..................**Cratomus** Dalman (type *Cynips megacephalus* Fabr.).

Head not cornuted; face with converging striæ below the insertion of the antennæ; abdomen longly petiolate, the body subcompressed towards apex, the petiole nearly twice as long as the hind coxæ.
Paracaratomus Ashmead (type *P. cephalotes* Ashm.).

Subfamily IV. Spalangiinæ.

1840. Spalangiides, Subfamily? (partim), Westwood, Intro. Mod. Class. Ins., II., Synop., p. 66.

1856. Spalangoidæ, Familie 6 (partim), Förster, Hym. Stud., II., pp. 18, 22 and 40.

1875. Spalangiina, Tribus (partim), Thomson, Hym. Skand., IV., pp. 12 and 206.

1886. Spalangiinæ, Subfamily (partim), Howard, Ent. Amer., I., p. 198.

1897. Spalangiinæ, Subfamily IV., Ashmead, Proc. Ent. Soc. Washington, IV., p. 248.

This subfamily is quite distinct from all of the others here defined by the peculiar oblong shape of the head, a character found in no other family in the Chalcidoidea, except in the family *Agaonidæ*, although not uncommon among the Aculeales, especially in the superfamily Vespoidea, the oblong head being one of the principal characters that distinguishes the family *Bethylidæ;* it is also reproduced in the *Chrysididæ* and occasionally in two or three other families.

Dr. Förster and others incorrectly placed here the genus *Asaphes* Walker (= *Isocratus* Förster); it is a genuine *Pteromaline.*

The subfamily *Spalangiinæ* is readily distinguished by the oblong shape of the head, by the antennæ being inserted far anteriorly close to the mouth, by the longer more depressed thorax, by the shape of the pronotum, by the petiolated abdomen, and by the venation of the front wings, the costal cell being long and exceedingly narrow.

The species of *Spalangia* are parasitic on dipterous larvæ. The species in the other genera, according to the records, destroy coleopterous larvæ.

TABLE OF GENERA.

1. Females.. 2
   Males.. 5

2. Head tridentate, with deep antennal furrows; a sharp, high carina or spine between the antennæ; marginal vein long 3
   Head normal, not tridentate 4
3. Head *with* a long spear-like process; mandibles very large, three fourths the length of the head; antennæ 10-jointed .... **Paralæsthia** Cameron (type *P. mandibularis* Cam.).
   Head *without* a long, spear-like process; mandibles not large; antennæ 9-jointed, sometimes apparently only 8-jointed, two of the terminal joints being closely united, without a visible suture between. **Cerocephala** Westwood (type *C. cornigera* Westw.).
4. Facial impression wanting; antennæ 10-jointed, inserted close to the mouth border..**Spalangia** Latreille (type *S. nigra* Latr.).
   Facial impressiom distinct; antennæ 9-jointed, inserted just above the clypeus. **Paraspalangia** Ashmead, g. nov. (type *P. annulipes* Ashm.).
5. Head not tridentate, normal 6
   Head tridentate, with deep antennal furrows and a long spine or sharp carina between 7
6. Mandibles very large, three fourths the length of the head; antennæ 10-jointed. .**Paralæsthia** Cameron.
   Mandibles normal, not large; antennæ 11 or 12-jointed .... **Cerocephala** Westwood.
7. Facial impression wanting; antennæ 12-jointed .... **Spalangia** Latreille.
   Facial impression distinct; antennæ (?) 10-jointed (broken) .... **Paraspalangia** Ashmead.

Subfamily V. Diparinæ.

1875. Diparides, Subtribus, Thomson, Hym. Skand., IV., 1875, p. 217.
1886. Diparides, Tribe, Howard, Ent. Amer., II., pp. 33 and 35.
1897. Diparinæ, Subfamily V., Ashmead, Proc. Ent. Soc. Washington, IV., p. 236.

The peculiarities in the venation of the front wings alone will distinguish this subfamily, although there are other characters not easily defined. The marginal vein is very long, as long, or nearly, as the subcostal vein, the costal cell being exceedingly narrow, the postmarginal vein is also long.

The head in front is convex or subconvex, not depressed, the antennæ being usually long and inserted on the middle of the face, the scape long and slender, the funicle 6-jointed, the club stouter and 3-jointed. The metathorax is longer than usual, with distinct lateral carinæ, while the abdomen is ovate, somewhat depressed, and distinctly petiolate.

The species are rare and only two genera have been characterized.

TABLE OF GENERA.

1. Females 2
   Males 4
2. Petiole linear, longer than the hind coxæ 3
   Petiole shorter than the hind coxæ.
   Abdomen oval; antennæ 13-jointed, subclavate, inserted near the middle of the face, the joints of the funicle stout, subequal, very gradually shortening .... **Panstenon** Walker (type *Miscogaster oxylus* Walk.).

3. Abdomen ovate; metathorax large, with delicate, irregular raised lines; second abdominal segment large, occupying fully one third or more of the whole surface of abdomen, the following segments short, subequal . . . . **Dipara** Walker (type *D. petiolata* Walk.).
4. Petiole linear, longer than the hind coxæ 5
   Petiole shorter, not longer than the hind coxæ.
   Antennæ filiform, not verticellate, pilose . . . . **Panstenon** Walker.
5. Antennæ with the joints of the flagellum well separated, subpeduunctate and somewhat verticellate-pilose; body of abdomen oval or rounded, the second segment occupying fully one half the whole surface . . . . **Dipara** Walker.

Family LXX. ELASMIDÆ.

1840. Eulophides, Subfamily 5 (partim), Westwood, Intro. Mod. Class. Ins., II.; Synop., p. 73.
1846. Eulophidæ, Family II. (partim), Walker, List Chalc. Brit. Museum, I., p. 61.
1856. Elasmoidæ, Familie 17, Förster, Hym. Stud., II., pp. 19, 25 and 71.
1878. Elasmina, Tribus, Thomson, Hym. Skand., V., p. 180.
1886. Elasminæ, Subfamily, Howard, Ent. Amer., I., p. 198.
1897. Elasmidæ, Family LXX., Ashmead, Proc. Ent. Soc. Washington, IV., p. 236.

This family is not closely allied to any other, although, on account of the 4-jointed tarsi, and the flabellate antennæ in the males, it deceptively resembles the family *Eulophidæ*. Structurally, however, the two families are totally distinct, the thorax, the front wings, the legs and the abdomen being quite different in these families.

In mesothoracic and abdominal characters the *Elasmidæ* show some affinity with the *Encyrtidæ*, but the relationship, if it ever existed, must have been very remote, in ages past, and it is not now traceable in the forms thus far discovered.

The group is easily recognized by the compressed, triangular shape of the body and abdomen, by the longer and narrower wings, by the venation, the marginal vein being usually, although not always, very long, with the stigmal vein very short, and by the abnormally developed legs, the hind coxæ being very large, strongly compressed, disk-like, the hind femora being rather stout, the tibiæ and tarsi being very slender, the latter being very long.

The species of *Elasmus* attack usually lepidopterous larvæ, but some have also been bred from microgasterid cocoons and from other insects. The Australia genus *Euryischia* Howard, attacks dipterous larvæ.

TABLE OF GENERA.

1. Females 2
   Males 3

2. Marginal vein shorter than the subcostal vein, the stigmal vein long, well developed; hind tibiæ armed with many long bristles .... **Euryischia** Howard (type *E. lestophoni* How.).
   Marginal vein very long, much longer than the subcostal, the stigmal vein minute; hind tibiæ unarmed, without long bristles.......................... **Elasmus** Westwood (type *Eulophus flabellatus* Fonsc.).
3. Marginal vein shorter than the subcostal, the stigmal vein long, well developed; antennæ simple, without branches .... **Euryischia** Howard.
   Marginal vein very long, longer than the subcostal, the stigmal vein very short; antennæ with *three* branches .... **Elasmus** Westwood.

Family LXXI. EULOPHIDÆ.

1840. Eulophides, Subfamily 5 (partim), Westwood, Intro. Mod. Class. Ins., p. 166; Synop., p. 73.
1843. Eulophini, Subfamily (partim), Haliday, Trans. Ent. Soc. London, III., p. 296.
1856. Myinoidæ, Familie 3 (partim), Förster, Hym. Stud., II., pp. 18, 21 and 30.
1856. Elachistoidæ, Familie 18 (partim), Förster, Hym. Stud., II., pp. 19, 26 and 72.
1856. Eulophoidæ, Familie 19 (partim), Förster, Hym. Stud., II., pp. 19, 26 and 74.
1856. Entedonoidæ, Familie 20 (partim), Förster, Hym. Stud., II., pp. 19, 26 and 78.
1856. Tetrastichoidæ, Familie 21 (partim), Förster, Hym. Stud., II., pp. 19, 26 and 83.
1878. Tetrastichina, Tribus (partim), Thomson, Hym. Skand., V., p. 180.
1885. Tetracampinæ, Subfamily (partim), Howard, Ent. Amer., I, p. 198.
1886. Tetracampinæ, Subfamily (partim), Howard, Ent. Amer., II., p. 98.
1900. Eulophidæ, Family LXXI., Ashmead, Proc. U. S. National Museum, XXIII., p. 203.

This very large family, which comprises mostly very small species, is separated from all the previously described families, except the *Elasmidæ*, by thoracic and pedal characters, and to a great extent also by venational peculiarities impossible to describe in detail to any except to those who have a thorough knowledge of the various families.

The principal points to be noted, however, are the axillæ which are advanced forward into the basal region of the parapsides, *on* or *before* an imaginary line drawn from tegula to tegula, a character found in none of the foregoing families, except the *Elasmidæ* which is too obviously distinct in many other ways to require specification again.

Five distinct subfamilies may be recognized by the aid of the following table:

TABLE OF SUBFAMILIES.

1. Submarginal vein entire, not distinctly broken, or interrupted before uniting with the marginal vein, and usually distinctly longer than the marginal; stigmal vein long, distinct, rarely very short, the postmarginal vein always present 3

   Submarginal vein broken, or interrupted before uniting with the marginal vein, and most frequently, but not always, very short; stigmal vein not or rarely long, usually very short, the knob most frequently subsessile or subpetiolate, the postmarginal most frequently wanting or very short, rarely long 2

2. Submarginal vein very short, the marginal vein very long, the postmarginal vein variable, often very short or only slightly developed; metapleura very small; abdomen often petiolate, but sometimes sessile or subsessile .... Subfamily I. ENTEDONINÆ.

   Submarginal vein not very short, usually longer than the marginal, the postmarginal vein *always* wanting; abdomen usually sessile, rarely petiolate.

   Stigmal vein very short, nearly obsolete, its knob sessile or subsessile; mesopleura usually without a femoral furrow .... Subfamily II. APHELININÆ.

   Stigmal vein distinct, never subsessile, usually long; mesopleura always with a distinct femoral furrow .... Subfamily III. TETRASTICHINÆ.

3. Mesonotum with the parapsidal furrows complete, distinct, entire .... Subfamily IV. ELACHERTINÆ.

   Mesonotum with the parapsidal furrows wanting or incomplete, at the most only slightly indicated anteriorly .... Subfamily V. EULOPHINÆ.

SUBFAMILY I. ENTEDONINÆ.

1897. Entedoninæ, Subfamily I., Ashmead, Proc. Ent. Soc. Washington, IV., p. 236.

The usually very long marginal vein, the usually very short stigmal vein, which is rarely long, the very small metapleura, and peculiarities in the shape of the head and abdomen, impossible to describe in detail, but which the trained eye recognizes at once, must be depended upon to distinguish the group.

The subfamily may be divided into *four* distinct tribes or minor groups.

TABLE OF TRIBES.

1. Tarsi in both sexes 4-jointed; funicle 5-jointed or less; antennæ 10-jointed or less. 2

   Tarsi in female 5-jointed, rarely heteromerous, in male 4-jointed; funicle 6-jointed; antennæ 11-jointed or more, never 10-jointed or less .... Tribe I. Tetracampini.

2. Parapsidal furrows complete, distinct.

   Abdomen sessile or subsessile, never distinctly petiolate .... Tribe II. Omphalini.

   Abdomen distinctly petiolate .... Tribe III. Entedonini.

   Parapsidal furrows incomplete, at the most indicated only anteriorly .... Tribe IV. Pediobiini.

TRIBE I. TETRACAMPINI.

1856. Tetracampoidæ, Familie, Förster, Hym. Stud., II., p. 79.

1878. Tetracampina, Tribus, Thomson, Hym. Skand., V., p. 181.

This tribe approaches nearest to the *Omphalini;* the body is rather narrow and elongate, the abdomen in the female being usually longer than the head and thorax

united and conically produced or conic-ovate; while the marginal vein is very long, the stigmal vein minute. In the females the tarsi are 5-jointed or heteromerous, in the males 4-jointed. The antennæ are 11-, 12- or 13-jointed, with 1 or 2 ring-joints, the funicle being 6-jointed.

In the other tribes the tarsi are 4-jointed in both sexes, the antennæ having at the most 10 joints, while the funicle is from 2- to 5-jointed.

The members of this tribe attack principally coleopterous larvæ.

TABLE OF GENERA.

1. Females; tarsi 5-jointed or heteromerous 2
   Males; tarsi 4-jointed 6
2. Antennæ 12- or 13-jointed, with 1 or 2 ring-joints 3
   Antennæ 11-jointed, without a ring-joint 5
3. Antennæ 12-jointed; mesonotal furrows distinct 4
   Antennæ 13-jointed, with 2 ring-joints, the scape slender, the club 3-jointed, the funicle 6-jointed, the joints long, cylindrical; mesonotal furrows wanting.
   Platynocheilus Westwood (type *P. erichsonii* Westw.).
4. Antennæ with the scape stout, the flagellum filiform, the joints cylindrical; stigmal vein very short with a very small knob .... **Tetracampe** Förster (type *Entedon panyas* Walk.).
   Antennæ with the scape slender, the flagellum subclavate, the joints except 5 and 6 a little longer than thick; stigmal vein short but with a rather large rounded knob... **Plutothrix** Förster (type unknown).
5. Scape not thick, the pedicel about as long as funicle-joints 1 and 2 united, the fifth joint stout; pronotum as long as the mesonotum, the axillæ widely separated; metanotum *without* a median carina.
   Försterella Dalla Torre (type *Hyperbius flavipes* Först.).
6. Antennæ 11- or 12-jointed; marginal vein normal 7
   Antennæ 13-jointed; marginal vein broad and stout .... **Platynocheilus** Westwood.
7. Antennæ 11-jointed 8
   Antennæ 12-jointed.
   Flagellum not verticillate-pilose; stigmal vein with a minute knob ....**Tetracampe** Förster.
   Flagellum verticillate-pilose; stigmal vein with rather a large knob ....**Plutothrix** Förster.
8. Antennæ with the scape broad, the pedicel long, the flagellum normal; stigmal vein very short.
   Försterella Dalla Torre.

TRIBE II. *Omphalini.*

Many of the species falling in this tribe strongly resemble some in the *Tetracampini,* in venation, in the shape of the body and in often having the abdomen conically produced, the only appreciable difference being in the antennæ; these are never more than 10-jointed, and the funicle is at the most 5-jointed, often 2-, 3- or 4-jointed.

The habits of the species, if the records are correct, are diverse. Some attack the larvæ of Coleoptera, while others attack those of Diptera, Lepidoptera, etc.

I am inclined to think, however, that these records in some cases are wrong and most of them will be found to be parasitic only on dipterous larvæ, since, where

the records conflict, Diptera are usually associated with the Coleoptera and Lepidoptera, either as parasites or living together in the same plant. In breeding parasites one cannot always ascertain, with absolute certainty, the host of the parasites.

Species belonging to the genus *Astichus* Förster are bred from fungi infested with dipterous and coleopterous larvæ.

TABLE OF GENERA.

1. Females.......... 2
   Males.......... 11
2. Antennæ 10-jointed, with *one* ring-joint (scape, pedicel, a ring-joint, a 4-jointed funicle and a 3-jointed club).......... 3
   Antennæ 9-jointed, with *one* ring-joint, or less than 9-jointed.......... 9
3. Wings hyaline, immaculate.......... 4
   Wings banded or maculate with fuscous.
   Antennæ very long, the flagellum subclavate; abdomen conically pointed; postmarginal vein short, the knob of the stigmal vein petiolate...**Astichus** Förster (type *A. arithmetricus* Först.).
4. Abdomen long, conically produced, as long or longer than the head and thorax united.......... 5
   Abdomen short, ovate or cordate and usually shorter than the thorax, never much longer.......... 8
5. Metanotum short, *without* carina or at the most with only a trace of a median carina.......... 6
   Metanotum long, distinctly tricarinate, the surface punctulate or rugulose.
   Flagellum stout, subclavate, finely pubescent; abdomen not longer than the head and thorax united or only a little longer.......... **Selitrichus** Roudani.
6. Metanotum smooth, impunctate.......... 7
   Metanotum punctate or sculptured.
   Wings almost glabrous, the short pubescence arranged in hair lines, usually conforming to the spurious veins; postmarginal vein well developed.......... **Secodes** Forster.
7. Front wings well pubescent; postmarginal vein well developed, long.
   Eyes not large, the malar space distinct; scape of antennæ metallic or metallic except at base. **Euderus** Haliday (type *Entedon amplus* Walk.).
   Eyes very large, pubescent, occupying the whole side of the head and extending to the base of the mandibles, the malar space wanting; scape very slender, white. **Euophthalmomyia** Ashmead, g. nov. (type *E. pallidipes* Ashm.).
   Front wings almost glabrous, not well pubescent, the pubescence arranged in more or less irregular hair-lines, as in *Secodes;* postmarginal vein not well developed, not or scarcely longer than the very short subsessile stigmal vein; eyes normal, the malar space distinct. **Omphale** Haliday (type *O. salicis* Hal.).
8. Wings bare or nearly, the stigmal vein rather long, the postmarginal vein not developed.
   Flagellum subclavate, not long, the pedicel long, obconical, the funicle 4-jointed, joints 3 and 4 wider than long; head lenticular, wider than the thorax; parapsidal furrows sharply defined posteriorly, wanting at anterior third; metathorax short, punctate, with a median carina; abdomen short cordate.......... **Hubbardiella** Ashmead, g. nov. (type *H. arizonensis* Ashm.).
9. Antennæ 8-jointed with a ring-joint.......... 10
   Antennæ 9-jointed, with a ring-joint, the funicle 3-jointed, the club 3-jointed, the terminal joint usually represented by a spur; wings immaculate, or at most with a substigmal fascia; metathorax smooth, without a median carina or lateral folds, but with spiracular sulci; abdomen not or scarcely longer than the head and thorax united.

Malar space distinct, the eyes not extending to the base of the mandibles; postmarginal vein very long .... **Chrysocharis** Förster.

Malar space wanting, the eyes large and extending to the mandibles; postmarginal vein very long, the stigmal vein subsessile and usually with a fuscous fascia from apex.

Zaommomyia Ashmead, g. nov. (type *Chrysocharis stigmata* Ashm.).

10. Wings usually with transverse fasciæ, the postmarginal vein not well developed; head wider than long; flagellum short, compressed, fusiform, the joints except the last wider than long.

Closterocerus Westwood (type *C. trifasciatus* Westw.).

11. Antennæ 10-jointed, with *one* ring-joint 12

Antennæ 9-jointed, with *one* ring-joint or less 16

12. Wings immaculate 13

Wings maculate.

Antennæ very long, verticillate-pilose, the funicle joints subdentate .... **Astichus** Förster.

13. Metanotum short, usually without a median carina 14

Metanotum not short, tricarinate.

Antennæ filiform .... **Selitrichus** Rondani.

14. Metanotum smooth, impunctate 15

Metanotum punctate or sculptured.

Wings subglabrous, the faint pubescence arranged in hair-lines; postmarginal vein well developed, longer than the stigmal .... **Secodes** Förster.

15. Front wings finely pubescent; postmarginal vein long, well developed.

Eyes not large, the malar space distinct; scape of antennæ metallic .... **Euderus** Haliday.

Eyes very large, occupying the whole sides of the head, the malar space wanting; scape of antennæ very slender, white .... **Euophthalmomyia** Ashmead.

Front wings subglabrous, not well pubescent, the pubescence arranged usually in more or less irregular hair-lines; postmarginal vein not well developed, rarely longer than the very short stigmal vein.

Head normal, not wider than the thorax; stigmal vein very short, the knob sessile or subsessile; parapsidal furrows complete; abdomen long .... **Omphale** Haliday.

Head very broad, lenticular, wider than the thorax; stigmal vein rather long; parapsidal furrows obliterated anteriorly .... **Hubbardiella** Ashmead.

16. Antennæ 8-jointed, with *one* ring-joint 17

Antennæ 9-jointed, with *one* ring-joint, the funicle 3-jointed.

Eyes normal, the malar space distinct .... **Chrysocharis** Förster.

Eyes very large, extending to base of mandibles, the malar space wanting.

Zaommomyia Ashmead.

17. Wings with a marginal fringe, often with transverse bands, the stigmal vein clavate, longer than the postmarginal .... **Closterocerus** Westwood.

Tribe III. *Entedonini.*

This tribe is easily distinguished from the *Omphalini* by the distinctly petiolate abdomen, and from the *Pediobiini* by the complete parapsidal furrows.

TABLE OF GENERA.

1. Females 2

Males 14

2. Scutellum *without* lateral longitudinal grooved lines, at the most with a single median furrow....... 7
Scutellum *with* lateral longitudinal grooved lines.
Antennæ 10-jointed, with only *one* ring-joint, or less than 10-jointed, the ovipositor never prominent.. 4
Antennæ 10-jointed, with *two* ring-joints, the ovipositor very long, longer than the abdomen; flagellum very long, the funicle 4-jointed, the joints long, swollen at base and tapering off at apex, the swollen portion with whorls of long hairs.
Uroentedon Ashmead, g. nov. (type *U. verticellata* Ashm.).
4. Head normal, viewed from in front not or scarcely wider than long; stigmal vein short........... 7
Head abnormal, viewed from in front very short, twice as wide as long or even wider; stigmal vein long.. 5
5. Eyes pubescent; wings with the disk usually subfuscous, but not banded; antennæ 10-jointed, subclavate.. 6
Eyes bare; wings with two fuscous transverse bands; antennæ 10-jointed, long, the flagellum long, subclavate, the funicle 4-jointed, the joints longer than thick; cylindrical; prothorax conical; parapsides prominently convex.......................**Hoplocrepis** Ashmead (type *H. albiclava* Ashm.).
6. Funicle 3-jointed, the joints cylindrical, slightly pedicellate, the club 4-jointed, black or brown-black, not white; metanotum smooth, without a median carina.
Eulophopteryx Ashmead, g. nov. (type *E. chapadæ* Ashm.).
Funicle 3-jointed, the joints compressed, briefly pedicellate, the club 4-jointed, white or yellowish white; metanotum with a median carina.
Lophocomus Haliday (type *Cirrospilus anaitis* Walk.).
7. Scutellum *without* a median longitudinal grooved line.. 8
Scutellum *with* a median longitudinal grooved line.
Antennæ 10-jointed, with one ring-joint, the flagellum filiform, pubescent, the funicle 4-jointed, the joints long, cylindrical; abdomen with a long petiole.
Holcopeltoideus Ashmead, g. nov. (type *Holcopelte petiolata* Ashm.).
Antennæ 9-jointed, with one ring-joint, usually subclavate, the funicle 3-jointed, the joints oblong-oval or submoniliform; abdomen with a short petiole.
Horismenus Walker (type *H. cleodora* Walk.).
8. Antennæ 9-jointed, with one ring-joint or less than 9-jointed................................. 10
Antennæ 10-jointed, with one ring-joint.
Metathorax *without* lateral carinæ.. 9
Metathorax *with* lateral carinæ and a median carina, the latter usually forked at apex.
Body of abdomen ovate, the first segment occupying about one third the whole surface.
Pleurotropis Förster (type *P. isomera* Först.).
9. Metathorax produced into a long neck at apex, with a delicate median carina at base.
Head very wide, lenticular, much wider than the thorax, concave behind; flagellum filiform, the funicle 4-jointed; postmarginal vein not developed; abdomen with a long petiole.
Pelorotelus Ashmead, g. nov. (type *P. cœruleus* Ashm.).
10. Antennæ 8-jointed, with one ring-joint, or less than 8-jointed.................................. 13
Antennæ 9-jointed, with one ring-joint, the funicle 3-jointed, the club 3-jointed, the last joint usually represented by a little spur.
Metathorax *without* lateral carinæ.. 11
Metathorax *with* lateral carinæ...............**Mestocharis** Förster (type *M. cyclopsila* Först.).

11. Scutellum not smooth, scaly punctate, or finely reticulately punctate.......................... 12
Scutellum perfectly smooth, impunctate..................**Asecodas** Förster (type *A. fuscipes* Först.).
12. Head very broad, much wider than the thorax, the occiput concave; metanotum with a median carina connected with a transverse carina *at* apex, the spiracles in depressions, large and oval.
Entedon Dalman (type *E. cyanellus* Dalm.).
Head not so broad, not or scarcely wider than the thorax; metanotum with a delicate median carina connected with a transverse carina *before* the apex, the same a little curved on each side from the apex of the median carina, the spiracles small, short oval or rounded........**Derostenus** Westwood (type *D. gemmeus* Westw.).
13. Antennæ short and strongly clavate, the funicle 2-jointed, the club large, 3-jointed.
Funicle joints neither small nor annular, distinctly separated; pedicel not large, much narrower than the first joint of funicle.......**Rhopalotus** Förster (type *Elachertus cothurnatus* Ratzeb.).
Funicle joints very minute, annular, and closely united with the club; pedicel large.
Chrysoatomus Ashmead, g. nov. (type *C. zealandicus* Ashm.).
14. Scutellum with *two* longitudinal grooved lines.. 15
Scutellum *without* longitudinal grooved lines, or at the most with a median grooved line.......... 19
15. Antennæ 10-jointed or less, with only *one* ring-joint 16
Antennæ 10-jointed with *two* ring joints...................................**Uroentedon** Ashmead.
16. Head abnormal, viewed from in front, very short and *twice* as wide as long, or even wider; stigmal vein long... 17
Head normal, viewed from in front, not or scarcely wider than long............................ 19
17. Eyes pubescent; wings with a subfuscous discal cloud but not banded; pronotum rounded before. 18
Eyes bare; wings with two transverse fuscous bands; pronotum conical.
Antennæ very long, 10-jointed, the joints of the funicle globose at base, longly petiolate at apex, with whorls of long hairs on the basal portion; sometimes also with short branches on the first three joints of funicle.......................................**Hoplocrepis** Ashmead.
18. Antennæ long, 10-jointed, as in *Hoplocrepis*.
Metanotum *without* a median carina..............................**Eulophopteryx** Ashmead.
Metanotum *with* a median carina.....................................**Lophocomus** Haliday.
19. Scutellum *with* a median longitudinal grooved line.. 20
Scutellum *without* a median longitudinal grooved line 21
20. Antennæ 10-jointed, the funicle 4-jointed, the joints rather longer, pedicellate at apex, the club 3-jointed.
Holcopeltoideus Ashmead.
Antennæ 9-jointed, the funicle 4-jointed, the joints oval, very briefly pedicellate, the club 2-jointed.
Horismenus Walker.
21. Antennæ 9-jointed, with a ring-joint, or less than 9-jointed..................................... 22
Antennæ 10-jointed, with a ring-joint, the funicle 4-jointed, the joints oblong, very briefly pedicellate, or loosely joined, the club 3-jointed, the last joint represented by a little spur.
Metanotum not short, with lateral carinæ and a median carina; abdomen short oval, the second segment occupying nearly half the whole surface, the following segments after the third very short...**Pleurotropis** Förster.
22. Antennæ 8-jointed or less 25
Antennæ 9-jointed.
Metathorax smooth, *without* lateral carinæ.. 23
Metathorax *with* lateral carinæ, the median carina also usually present.

Flagellum short, stout, subclavate, the funicle 3-jointed, joints 2 and 3 not longer than thick, the club stouter, ovate.................................. **Mestocharis** Förster.

23. Scutellum never smooth, always punctate, scaly-punctate or reticulate; metanotum more or less shagreened or punctate.. 24

Scutellum always smooth, impunctate; metanotum smooth, not sculptured.

Flagellum subfiliform, much stouter than the small pedicel, the funicle 3-jointed, the joints loosely joined or briefly pedicellate, postmarginal vein short.............. **Asecodes** Förster.

24. Flagellum filiform, the funicle 3-jointed.

Metanotum with a transverse carina at apex; postmarginal vein short....... **Entedon** Dalman.

Metanotum with a tranverse carina a little before the apex; postmarginal vein long. **Derostenus** Westwood.

25. Antennæ short, strongly clavate, pubescent.

Pedicel not large, narrower than the first joint of the funicle............. **Rhopalotus** Förster.

Pedicel very large, stouter than the first joint of the funicle.......... **Chrysoatomus** Ashmead.

TRIBE IV. *Pediobiini.*

In this tribe are found some of the smallest members of the subfamily. It is distinguished from the other tribes by having the mesonotal furrows incomplete or wholly wanting, at the most indicated by a slight depression posteriorly, but not by grooved lines. In the other tribes the mesonotal or parapsidal furrows are usually complete and always sharply defined, the mesonotum being distinctly trilobed.

All of the species falling in this group, or tribe, are, I think, hyperparasites and attack other members of the *Entedoninæ*, as well as members of other groups, and more particularly species in the *Eulophinæ*; they are the cannibals of the *Eulophidæ*, since they attack and devour almost any member of the family, the species of the genus *Eulophus* particularly being most frequently devoured by them.

TABLE OF GENERA.

1. Females.. 2

Males.. 8

2. Abdomen sessile or subsessile, the petiole very short.. 3

Abdomen distinctly petiolate.

Head lenticular, wider than the thorax; abdomen conically pointed, the second segment large, occupying most of the surface; antennæ 8-jointed (or 9-jointed with a ring-joint), the funicle 3-jointed, the joints oval, loosely joined or subpedunculate; postmarginal vein very short. **Paracrias** Ashmead, g. nov. (type *P. laticeps* Ashm.).

3. Ovipositor not exserted.. 4

Ovipositor exserted, the length of the abdomen.

Wings with long marginal cilia, the postmarginal vein long, the stigmal vein short; head transverse; antennæ? (broken, probably 8-jointed)............ **Uroderostenus** Ashmead, g. nov. (type *U. pleuralis* Ashm.).

4. Wings with long marginal cilia.. 5

Wings with short marginal cilia.. 6

5. Marginal vein very long.

Stigmal vein long; antennæ 8-jointed (or 9-jointed with a ring-joint), the funicle 3-jointed, the joints longer than thick .... **Chrysonotomyia** Ashmead, g. nov. (type *Eulophus auripunctatus* Ashm.).

Stigmal vein short; antennæ 9-jointed, with a ring-joint, the flagellum filiform, tapering off at apex, and furnished with long, sparse hairs, the funicle 3-jointed; abdomen long, conic-ovate. **Ametallon** Ashmead, g. nov. (type *A. chapadæ* Ashm.).

6. Antennæ 7-jointed (or 8-jointed with a ring-joint), if 9-jointed the head not especially large 7

Antennæ 8-jointed (or 9-jointed with a ring-joint); head large, wider than the thorax.

Flagellum slender, filiform, clothed with some long, sparse hairs, the funicle and club each 3-jointed; head large, much wider than the thorax; wings with one or two fuscous fasciæ; abdomen conic-ovate, the second segment occupying scarcely half the whole surface. **Acrias** Walker (type *A. nileus* Walker).

7. Stigmal vein usually very short, the knob sessile or subsessile.

Thorax and scutellum smooth, impunctate; antennæ 8-jointed, with a ring-joint, not tapering toward apex, the joints of the funicle submoniliform. **Pediobius** Walker (type *Entedon cœdicius* Walk.).

Thorax and scutellum with a scaly punctation; antennæ 9-jointed with a ring-joint, tapering off at apex, the joints of the funicle not submoniliform. **Nesomyia** Ashmead, g. nov. (type *N. albipes* Ashm.).

8. Abdomen sessile or subsessile 9

Abdomen distinctly petiolate.

Antennæ 9-jointed with one ring-joint .... **Paracrias** Ashmead.

9. Wings with short marginal cilia 10

Wings with long marginal cilia.

Stigmal vein short.

Non-metallic .... **Ametallon** Ashmead.

Metallic .... **Uroderostenus** Ashmead.

Stigmal vein long .... **Chrysonotomyia** Ashmead.

10. Antennæ 8-jointed (or 9-jointed with a ring-joint) .... **Acrias** Walker.

Antennæ 7-jointed (or 8-jointed with a ring-joint) .... **Pediobius** Walker.

Subfamily II. Aphelininæ.

1856. Myinoidæ, Familie, 3, Förster, Hym. Stud., II., pp. 18, 21 and 30.

1875. Aphelinina, Tribus, Thomson, Hym. Skand., IV., pp. 12, 183.

1886. Aphelininæ, Subfamily, Howard, Ent. Amer., I., p. 198.

1897. Aphelininæ, Subfamily, II., Ashmead, Proc. Ent. Soc. Washington, IV., p. 236.

Many authorities have treated this group as allied to the *Encyrtidæ*, and usually place it next to that family, with which it has no affinity whatever. It is clearly a component of the *Eulophidæ*, where Dalman first placed it, as is shown by the structural characters of the mesothorax.

An excellent reversion of the group has been given by Dr. L. O. Howard, in Technical Series No. 1. U. S. Department of Agriculture, where most of the genera have been fully described and figured.

TABLE OF TRIBES.

Tarsi 5-jointed..Tribe I. Aphelinini.
Tarsi 4-jointed..Tribe II. Pteroptricini.

Tribe I. *Aphelinini.*

The *five*-jointed tarsi distinguish the tribe. The majority of the species confine their attacks to various genera of scale-insects, or bark-lice, belonging to the family *Coccidæ*. A few, however, in the genus *Aphelinus*, while usually bred from *Coccidæ*, also attack plant-lice belonging to the family *Aphididæ*. All the species, except probably the latter, which may be hyperparasitic on some *Encyrtinæ*, are supposed to be primary parasites, and are of the greatest importance in destroying the destructive bark-lice (*Coccidæ*).

TABLE OF GENERA.

1. Females.. 2
   Males..19
2. Wingless forms..18
   Winged.
      Front wings *with* a hairless oblique line extending from the marginal vein towards the base of the wing; antennæ 5- or 6-jointed..12
      Front wings *without* such a line.
         Antennæ 8-jointed.. 3
         Antennæ 3-jointed..11
3. Club of antennæ 3-jointed.. 4
   Club of antennæ 1- or 2-jointed.. 8
4. Wings with a short marginal fringe.. 5
   Wings with a long marginal fringe.. 7
5. Stigmal vein short but distinct, always present.
      Marginal vein as long as, or longer than, the subcostal vein.. 6
      Marginal vein much shorter than the subcostal vein.
      Prospalta Howard (type *P. murtfeldti* How.).
6. Flagellum strongly compressed, the first joint of the funicle about twice as long as the pedicel, the following shortening; hind tibiæ flat, with short stiff bristles behind.
   Aneristus Howard (type *A. ceroplastæ* How.).
   Flagellum not compressed, subcylindrical, the first joint of funicle not twice as long as the pedicel. hind tibiæ normal, without short, stiff bristles behind.
   Coccophagus Westwood (type *C. pulchellus* Westw.).
7. Stigmal vein absent........................**Aspidiotiphagus** Howard (type *Coccophagus citrinus* Craw.).
8. Club of antennæ 2-jointed.. 9
   Club of antennæ 1-jointed..10
9. Abdomen, seen from above, short, oval, depressed, beneath boat-shaped or carinate; hind tibiæ normal..**Encarsia** Förster (type *E. tricolor* Först.).
   Abdomen, seen from above, subovate, flat, beneath subconvex; hind tibiæ behind armed with stiff bristles..**Myiocnema** Ashmead (type *M. comperei* Ashm.).
10. Abdomen short, depressed, not boat-shaped beneath, ending in a prominent ovipositor.
   Ablerus Howard (type *Centrobia clisiocampæ* Ashm.).

11. Front wings with long marginal cilia, dusky on basal half; club, or terminal joint of the 3-jointed antennæ, very long . . . . **Thysanus** Haliday (type *T. ater* Hal.).
12. Antennæ 6-jointed 13
Antennæ 5-jointed 17
13. Antennæ with the three joints before the club *unequal* in length 14
Antennæ with the three joints before the club *equal* in length . . . . **Mesidia** Förster.
14. Ovipositor prominently exserted 15
Ovipositor not at all, or at most only slightly, exserted; wings hyaline . . . . **Aphelinus** Dalman (type *Entedon abdominalis* Dalm.).
15. Wings not wholly hyaline, maculate, or with rounded fuscous spots 16
Wings hyaline; with a brown band; post-scutellum abnormal, extending to the base of the abdomen; ovipositor prominent, $\frac{1}{3}$ the length of the abdomen . . . . . . **Centrodora** Förster (type *C. amœna* Först.).
16. Wings hyaline, with rounded, fuscous spots . . . . . . **Marietta** Motschulsky (type *M. leopardina* Motsch.).
Wings strongly maculate, with broad irregular fuscous bands and spots of a peculiar pattern. **Perissopterus** Howard (type *Aphelinus pulchellus* How.).
17. Ovipositor exserted; mandibles 3-dentate . . . . **Physcus** Howard (type *Coccophagus varicornis* How.).
18. Antennæ 6-jointed . . . . **Aphelinus** Dalman.
19. Front wings with a hairless oblique line; antennæ 5- or 6-jointed 25
Front wings without such a line.
Antennæ 8-jointed 20
Antennæ 3-jointed.
Wings with long marginal cilia . . . . **Thysanus** Haliday.
20. Front wings with the marginal cilia short 21
Front wings with the marginal cilia long 23
21. Marginal vein much shorter than the subcostal vein 22
Marginal vein as long as or longer than the subcostal vein . . . . **Coccophagus** Westwood.
22. Hind tibiæ not armed with stiff bristles behind . . . . **Prospalta** Howard.
Hind tibiæ armed with stiff bristles behind . . . . **Myiocnema** Ashmead.
23. Front wings broadly rounded at apex, the stigmal vein present 24
Front wings narrowed and pointed at apex, the stigmal vein absent . . . . **Aspidiotiphagus** Howard.
24. Unknown . . . . **Ablerus** Howard.
. . . . **Encarsia** Förster.
25. Antennæ 6-jointed 26
Antennæ 5-jointed.
26. Antennæ with the three joints before the club of an *unequal* length 27
Antennæ with the three joints before the club of an equal length . . . . **Mesidia** Förster.
27. Wings not wholly hyaline 28
Wings wholly hyaline . . . . **Aphelinus** Dalman.
28. Wings with rounded fuscous spots or strongly maculate with fuscous bands and irregular spots 29
Wings hyaline except a fuscous band . . . . **Centrodora** Förster.
29. Wings with rounded fuscous spots . . . . **Marietta** Motschulsky.
Wings strongly maculate with broad irregular fuscous bands and spots of a peculiar pattern. **Perissopterus** Howard.

Tribe II. *Pteroptricini.*

This tribe is separated from the former by having 4-jointed tarsi, not five. It forms a transition, or a connecting link, between the subfamilies *Aphelininæ* and the *Tetrastechinæ*, some of its members are easily mistaken for some of those of the latter.

The very short, or nearly obsolete, stigmal vein, and the absence of the mesosternal furrow, will, however, readily distinguish them.

The species attack principally the mealy-winged plant-lice, family *Aleurodidæ*.

TABLE OF GENERA.

1. Females.. 2
   Males.. 3
2. Antennæ 8 jointed, normal, the last joint very short. **Pteroptrix** Westwood (type *P. dimidiata* Westw.).
   Antennæ 5-jointed, with 2 minute ring-joints, the last joint, or the club, greatly lengthened.
   Eretmocera Haldeman (type *E. corni* Haldeman.).
3. Antennæ 8-jointed...**Pteroptrix** Westwood.
   Antennæ 3-jointed (or 4-jointed with a ring-joint), the last joint very long. **Eretmocera** Haldeman.

Subfamily III. Tetrastichinæ.

1856. Tetrastichoidæ, Familie 21, Förster, Hym. Stud., II., pp. 26 and 83.
1878. Tetrastichina, Tribus, Thomson, Hym. Skand., V., p. 180.
1886. Tetrastichinæ, Subfamily, Howard, Ent. Amer., I., p. 199; II., p. 98.
1897. Tetrastichinæ, Subfamily III., Ashmead, Proc. Ent. Soc. Washington, IV., p. 249.

This subfamily is closely allied to the *Aphelininæ*, and some of the smaller species falling in it, are easily confused with many in the *Aphelinini*, if attention is not given to the difference in the length of the stigmal vein.

TABLE OF TRIBES.

Abdomen distinctly petiolate; hind wings with a long, clavate marginal vein.......Tribe I. Ceratoneurini.
Abdomen sessile or subsessile; hind wings with a slender marginal vein..........Tribe II. Tetrastichini.

Tribe I. *Ceratoneurini.*

The distinctly petiolate abdomen, and the long clavate marginal vein in the hind wings, found in no other tribe, will distinguish the tribe at a glance.

Only one genus is known:

Antennæ 10-jointed, with *two* ring-joints; face with striæ converging towards the mouth.
Ceratoneura Ashmead (type *C. petiolata* Ashm.).

Tribe II. *Tetrastichini.*

The sessile or subsessile abdomen, and the difference in the venation of the hind wings separate this tribe from the *Ceratoneurini*. The scutellum has usually *four*

longitudinal grooved lines, rarely *five*, but never less than *two* longitudinal grooved lines.

The species falling in this group are not restricted in their habits, but attack nearly all orders of insects. They have been bred, according to the records, from the larvæ of Coleoptera, Lepidoptera, Hymenoptera, Diptera, Orthoptera, Neuroptera, Odonata, etc., and appear to be both primary and secondary parasites.

The vast majority of them, however, appear to be primary parasites upon the gall-making or gall-inhabiting insects in the Orders Diptera, Hymenoptera and Coleoptera.

The curious, and in some respects anomalous, genus *Melittobia* Westwood is parasitic in the nests of bees and wasps, and is said to attack not only these insects but also other hymenopterous parasites of the bees and the wasps, *i. e.*, *Monodontomerus*, etc. In this country species have been bred from the nests of bees and wasps, just as in Europe, but here we have *positive* evidence that they came from the puparium of a Dipteron, and I have, therefore, my doubts as to the genus being a primary parasite of bees and wasps.

TABLE OF GENERA.

1. Females 2
   Males 13
2. Mesonotum *without* a median grooved line 3
   Mesonotum *with* a median grooved line 7
3. Pronotum transverse, *not* conical, or subquadrate or rounded anteriorly 4
   Pronotum long, conical.
      Antennæ 9-jointed, inserted near the mouth border; abdomen longer than the head and thorax united, subcompressed, the ventral valve prominent .... **Melittobia** Westwood (type *Cirrospilus acasta* Walk.).
4. Antennæ 9-jointed, with *one* ring-joint 6
   Antennæ 10-jointed, with *two* ring-joints.
      Abdomen very long, conically produced, two or more times longer than head and thorax united 5
      Abdomen not long, either ovate or conic-ovate and not or rarely much longer than the head and thorax united.
         Abdomen above depressed or concave, never cylindrical, either carinate or convex beneath, polished, the segments not subequal .... **Tetrastichodes** Ashmead (type *T. floridanus* Ashm.).
         Abdomen cylindrical, convex above, never depressed, shagreened or punctate, never smooth, the segments subequal; funicle joints cylindrical, at least twice as long as thick .... **Trichoporus** Förster (type unknown).
5. Metanotum usually very short, with a Λ-shaped median carina, each fork diverging towards the lateral hind angle, more rarely with a straight median carina .... **Hyperteles** Förster (type *Eulophus elongatus* Förster).

6. Scutellum with *two* longitudinal grooved lines; hind wings acutely pointed; front wings with a long marginal fringe.................................**Gyrolasia** Förster (type *Pteroptrix menes* Walk.).

Scutellum with *four* longitudinal grooved lines; hind wings *not* acutely pointed.

Head and thorax smooth or nearly, at the most only sparsely punctate, metanotum smooth, with a delicate median carina; abdomen rotund or broadly oval, shorter than the thorax but wider.........................**Syntomosphyrum** Förster (type *Eulophus cyclogaster* Ratz.).

Head and thorax shagreened or punctate, as well as the abdomen; metanotum punctate; abdomen rather long, cylindrical, the segments subequal.......**Trichoporus** Förster (partim).

7. Scape of antennæ normal, neither greatly thickened nor dilated.................................. 8

Scape of antennæ abnormal, enormously enlarged, or dilated; antennæ 9-jointed with *one* ring-joint, the funicle 4-jointed.

Front wings with a long marginal fringe; funicle joints short, moniliform....**Ceranisus** Walker (type *C. pacuvius* Walk.).

Front wings with a short marginal fringe; funicle joints longer than thick. **Baryscapus** Förster (type unknown).

8. Antennæ 10-jointed, with *two* ring-joints, the funicle 3-jointed, the club ovate, 3-jointed........... 9

Antennæ 9-jointed, with *one* ring-joint, or less than 9-jointed.................................. 10

9. Abdomen ovate or conic-ovate, rarely, although sometimes, greatly lengthened and conically produced as in *Hyperteles*..............................**Tetrastichus** Haliday (type *Eulophus miser* Nees).

10. Antennæ 9-jointed, with *one* ring-joint.. 11

Antennæ 8-jointed, with *one* ring-joint.. 12

11. Front legs normal, the tibiæ and tarsi long and slender; pronotum not long, rounded before, hardly half the length of the mesonotum; abdomen much elongate, conically produced, subcompressed, with usually a prominent ovipositor; funicle joints much longer than thick......**Aprostocerus** Westwood (type *A. caudatus* Westw.).

Front legs abnormal, much swollen, the tibiæ short and thick; pronotum large, transverse quadrate, nearly as long as the mesonotum, the front angles a little rounded; body of abdomen oblong, depressed, not longer than the head and thorax united, the ovipositor prominent but not longer than half the length of the abdomen; funicle joints short, not longer than thick, sometimes a little wider than long.....................................**Cratæpus** Förster (type *C. agrisgranensis* Först.).

12. Abdomen ovate, the ovipositor hidden.

Antennæ very short, clavate, the pedicel obconic, thicker and longer than the first two joints of the funicle united, which are small, quadrate; wings with a long marginal fringe. **Pentastichus** Ashmead (type *P. xanthopus* Ashm.).

13. Mesonotum *without* a median grooved line.. 14

Mesonotum *with* a median grooved line.. 21

14. Species fully winged.. 15

Apterous or subapterous.

Pronotum long, conical; antennæ 9-jointed, inserted close to the mouth, the scape long, broadly dilated towards apex, the pedicel and first funicle joint dilated, the funicle joints 2–4 small, transverse, the club ovate, 3-jointed...........**Melittobia** Westw.

15. Antennæ 9-jointed with *one* ring-joint.. 16

Antennæ 8-jointed or less.. 20

16. Front wings with a short marginal fringe, the hind wings not acutely pointed at apex........... 17

Front wings with a long marginal fringe, the hind wings acutely pointed at apex. **Gyrolasia** Förster.

17. Abdomen short oval, or rotund, shorter than the thorax.......... 19
Abdomen elongate, conic-ovate or conical, fully as long as, or longer than, the thorax.
Metanotum not punctate, the abdomen neither cylindrical nor sculptured, the segments not subequal, the head and thorax smooth, not strongly sculptured or closely punctate....... 18
Metanotum very short and punctate, the abdomen cylindrical, sculptured, the segments short, subequal, the head and thorax closely punctate or strongly sculptured...**Trichoporus** Förster.
18. Metanotum very short, smooth, and often without a median carina; if the median carina is present it is united with a transverse apical carina; abdomen not longer than the thorax.
Tetrastichodes Ashmead.
Metanotum short, with a ʌ-shaped median carina; abdomen very long, conically produced, much longer than the thorax..........**Hyperteles** Förster.
19. Species small and short, black or at most æneous black, the abdomen rotund, never ovate or conically pointed..........**Syntomosphyrum** Förster.
20. Antennæ 8-jointed, *without* a ring-joint.
Abdomen ovate or conically pointed.
Abdomen short rotund..........**Syntomosphyrum** Förster (partim).
Abdomen not short, ovate, or conic-ovate..........**Tetrastichodes** Ashmead (partim).
21. Scape of antennæ normal, neither greatly thickened nor dilated.......... 22
Scape of antennæ enormously enlarged or dilated.
Front wings with a long marginal fringe; flagellum filiform, slender, with a short pubescence.
Ceranisus Walker.
Front wings with a short marginal fringe..........**Baryscapus** Förster.
22. Antennæ 9-jointed, with *one* ring-joint.......... 23
Antennæ 8-jointed, with *one* ring-joint.......... 25
23. Front legs swollen, their tibiæ short.......... 24
Front legs normal, their tibiæ not short.
Flagellum long, *with* long sparse hairs..........**Tetrastichus** Haliday.
Flagellum not especially long, *without* long sparse hairs; metanotum smooth, without a median carina..........**Aprostocerus** Westwood.
24. Pronotum transverse quadrate, not short; abdomen oval, shorter than the thorax...**Cratæpus** Förster.
25. Flagellum clavate, hairy, the funicle 2-jointed, the joints transverse; pronotum very short; abdomen ovate, not longer than the thorax..........**Pentastichus** Ashmead.

Subfamily IV. Elachertinæ.

1856. Elachistoidæ, Family 18 (partim), Förster, Hym. Stud., II., pp. 19, 26 and 72.
1875. Elachistina, Tribus (partim), Thomson, Hym. Skand., V., p. 180.
1886. Elachistinæ, Subfamily (partim), Howard, Ent. Amer., I., p. 198; II., p. 99.
1897. Eulophinæ, Subfamily IV. (partim), Ashmead, Proc. Ent. Soc. Wash., IV., p. 249.

This subfamily is based upon the genus *Elachertus* Spinola, established in 1811. Walker changed it to *Elachestus* which held sway until 1856, when Förster changed it to *Elachistus*, making it the type of his family *Elachistoidæ*. I restore the original spelling of the genus and call the subfamily *Elachertinæ*. The continual change in

the spelling of long-established genera is most annoying, confusing and difficult to follow and I hold, with many other zoölogists, that the only way to free ourselves from these perplexities is to adhere strictly to the original spelling and to treat all genera incorrectly formed as mere combinations of letters without special significance. In no other way can we secure permanency in nomenclature.

All the species falling in this subfamily are apparently parasitic only upon the larvæ of Lepidoptera, and more especially upon various families in the suborder Heterocera, particularly those belonging to the families *Bombycidæ, Noctuidæ, Geometridæ* and *Tortricidæ.*

Four minor groups, or tribes, have been recognized, distinguished by the number and length of the hind tibial spurs.

TABLE OF TRIBES.

1. Hind tibiæ with only *one* apical spur.. 2
   Hind tibiæ with *two* apical spurs.
      Hind tibial spurs *very* long; pronotum anteriorly acute ....Tribe I. Euplectrini.
      Hind tibial spurs normal, never very long; pronotum anteriorly rounded..Tribe II. Ophelinini.
2. Hind tibial spur normal, rarely very long.................................. Tribe III. Elachertini.

TRIBE I. *Euplectrini.*

This tribe is easily separated from the others by the two very long apical spurs of the hind tibiæ, the inner spur being very nearly as long as the basal joint of the tarsi.

Although parasitic upon lepidopterous larvæ, like the other tribes, it differs widely from the others, whose habits are known, in that the larvæ are either external feeders, or on reaching maturity, gnaw their way out of their host and spin small silk cocoons, like some of the *Braconidæ*, within which they pupate and undergo their final transformation. All of the others either pupate as naked pupæ, without a cocoon, within the body of their hosts, or emerge and attach themselves to the under or upper side of a leaf, or else conceal themselves in some convenient crevice or under loose bark.

TABLE OF GENERA.

1. Females.. 2
   Males... 3
2. Scape in both sexes normal, slender; postmarginal vein distinctly longer than the stigmal vein.
   Euplectrus Westwood (type *Pteromalus bicolor* Swederus).
   Scape in male abnormally enlarged, swollen; postmarginal vein not longer than the stigmal.
   Pachyscapha Howard (type *P. insularis* How.).
3. Scape of antennæ normal.. **Euplectrus** Westwood.
   Scape of antennæ enormously enlarged..................................**Pachyscapha** Howard.

Tribe II. *Ophelinini.*

The much shorter hind tibial spurs separate this tribe from the *Euplectrini.* The pronotum is also different, more rounded anteriorly, and the hind coxæ are not so much swollen.

It is difficult sometimes to tell whether or not the abdomen is petiolate or sessile, and in two or three cases I have been compelled to put certain genera in both categories, the petiole being so short as to give the abdomen the appearance of being sessile.

TABLE OF GENERA.

1. Females.......... 2
   Males.......... 14
2. Abdomen distinctly petiolate.......... 3
   Abdomen sessile or subsessile.......... 11
3. Scutellum with *two* dorsal grooved lines.......... 4
   Scutellum *without* dorsal grooved lines.......... 9
4. Body metallic.......... 5
   Body *not* metallic.......... 10
5. Eyes bare, not pubescent.......... 8
   Eyes pubescent; antennæ 9-jointed.......... 6
6. Abdomen ovate or oblong-oval, shorter than the thorax.......... 7
   Abdomen conic-ovate, not shorter than the thorax, the second segment large; funicle 4-jointed, the joints cylindrical, longer than thick; metathorax produced into a subglobose neck.
   Scutellum *with* a median grooved line; mesothoracic furrows distinct.
   Diglyphomorpha Ashmead, g. nov. (type *Diglyphus maculipennis* Ashm.).
   Scutellum *without* a median grooved line; mesothoracic furrows very delicate although complete, appearing incomplete without the aid of a strong lens.......... **Ardalus** Howard (type *A. aciculatus* How.).
7. Antennæ 9-jointed, the funicle 4-jointed, subcompressed, joints 3–4 wider than long; scutellum without grooved lines.......... **Leucodesmia** Howard (type *L. typica* Howard).
   Antennæ 10-jointed, the funicle joints longer than wide.
   Scutellum with 2 dorsal grooved lines.......... **Elachertomorpha** Ashmead, g. nov. (type *E. flaviceps* Ashm.).
8. Antennæ 10-jointed, the funicle 4 jointed, the joints loosely joined; abdomen globose, the petiole long, slender; scutellum with two grooved lines.......... **Stenomesius** Westwood.
   Antennæ 10-jointed, with *one* ring-joint.......... 10*
9. Antennæ 9-jointed with *two* ring-joints.......... 10
   Antennæ 9-jointed, with one ring-joint; the funicle 4-jointed, eyes pubescent; funicle joints compressed, joints 3–4 wider than long; abdomen oval or ovate, shorter than the thorax...... **Leucodesmia** Howard (type *L. typica* How.).
10. Antennæ 9-jointed.
    Pronotum campanulate; pedicel long, obconic. **Miotropis** Thomson (type *M. sulcicris* Thoms.).
    Pronotum quadrate; pedicel not long.......... **Dichotomus** Förster (type *D. acerinus* Först.).

10*. Body of abdomen ovate as long or longer than the thorax, the petiole very short.
    Sympiesomorpha Ashmead, g. nov. (type *S. brasiliensis* Ashm.).

Body of abdomen subglobose or ovate, much shorter than the thorax, the petiole usually long.
Stenomesius Westwood (type *Ichneumon rufescens* Rossi).

11. Scutellum with *two* dorsal grooved lines.......... 12
    Scutellum *without* dorsal grooved lines.......... 13
12. Antennæ 9-jointed.
    Metallic; scutellum with a median grooved line; eyes pubescent.
    Diglyphomorpha Ashmead (partim).
    Antennæ 10-jointed, with *one* ring-joint, the funicle 4-jointed, the club 3-jointed.
    Non-metallic; metathorax with a median carina; marginal vein as long as or a little longer than the submarginal, the stigmal vein only about one third the length of the marginal.
    Alophus Ashmead, g. nov. (type *A. flavus* Ashm.).
    Antennæ 10-jointed, with *one* ring-joint, the club not thickened, tibial spurs short.
    Sympiesomorpha Ashmead, g. nov. (type *S. brasiliensis* Ashm.).
13. Antennæ 9-jointed, with *one* ring-joint, the club thickened, 3-jointed; tibial spurs long.
    Ophelinus Haliday (type *Eulophus ursidius* Walk.).
14. Abdomen distinctly petiolate.......... 15
    Abdomen sessile or subsessile.......... 22
15. Scutellum with *two* dorsal grooved lines.......... 16
    Scutellum *without* dorsal grooved lines-.......... 21
16. Body metallic.......... 17
    Body not metallic.......... 19
17. Eyes bare, not pubescent.......... 20
    Eyes pubescent.
    Antennæ, 9-jointed with one ring-joint.......... 18
    Antennæ 8-jointed, with one ring-joint.
18. Scutellum *with* a median grooved line; mesothoracic furrows very distinct. **Diglyphomorpha** Ashm.
    Scutellum *without* a median grooved line; mesothoracic furrows very delicate.... **Ardalus** Howard.
19. Antennæ 9-jointed, with one ring-joint, the funicle 4-jointed, the club ovate, 2-jointed, the flagellum compressed, the joints of the funicle excised at apex above.......... **Leucodesmia** Howard.
20. Antennæ 10-jointed, with 1 ring-joint, the funicle 4-jointed, the club 3-jointed, the funicle with 3 branches.......... **Teleogmus** Förster.
21. Antennæ 9-jointed, with two ring-joints.
    Pronotum campanulate.......... **Miotropis** Thomson.
    Pronotum quadrate.......... **Dichotomus** Förster.
22. Scutellum *with* 2 dorsal grooved lines.......... 23
    Scutellum *without* dorsal grooved lines.......... 25
23. Antennæ 10-jointed, with *one* ring-joint, the funicle 4-jointed, the club 3-jointed.......... 24
    Antennæ 9-jointed, with *one* ring-joint, the funicle 3-jointed.
    Metallic; scutellum with a median grooved line.......... **Diglyphomorpha** Ashmead.
24. Non-metallic.
    Abdomen with a very short petiole.......... **Alophus** Ashmead.
    Abdomen with a long petiole.......... **Stenomesius** Westwood.
25. Antennæ 9-jointed.......... **Ophelinus** Haliday.

TRIBE III. *Elachertini.*

This tribe may be at once recognized from the two tribes previously defined by the hind tibiæ having only *one* apical spur; otherwise it is scarcely distinguishable from the *Ophelinini*, many genera falling in it being easily confused with some in that tribe.

TABLE OF GENERA.

1. Females 2
   Males 14
2. Abdomen distinctly petiolate 3
   Abdomen sessile or subsessile 5
3. Scutellum with two dorsal grooved lines.
   Body neither wholly black or wholly metallic, more or less yellow or marked with yellow... 4
   Body metallic or wholly black; abdomen ovate, hardly as long as the thorax, or rounded; antennæ 9-jointed (or 10-jointed, with *one* ring-joint), the funicle 4-jointed, the joints not or very little longer than thick .... **Elachertus** Spinola (type *E. abdominalis* Spinola).
4. Abdomen conic-ovate, barely longer than the thorax; antennæ 10-jointed with one ring-joint, the funicle 4-jointed, the joints long, loosely joined, the club 3-jointed, marginal vein very long.
5. Scutellum with *two* dorsal grooved lines 6
   Scutellum *without* dorsal grooved lines 9
6. Head, viewed from in front, wider than long and not especially thin antero-posteriorly 7
   Head, viewed from in front, much longer than wide, and very thin antero-posteriorly 8
7. Body *not* metallic, the head and thorax marked with yellow.
   Antennæ 9-jointed, with *one* ring-joint, the pedicel much longer than wide, the funicle 3-jointed, subcompressed, the club 3-jointed .... **Cirrospilus** Westwood (type *C. elegantissimus* Westw.).
   Antennæ 10-jointed, with *one* ring-joint, the pedicel short, only a little longer than thick, the funicle 4-jointed, the club 3-jointed .... **Cirrospiloideus** Ashmead, g. nov. (type *Miotropis platynotæ* Howard).
   Body metallic; antennæ 10-jointed, with *one* ring-joint, the pedicel longer than wide, the funicle 4-jointed, joints 2–4 not longer than thick .... **Elachertus** Spinola (partim).
8. Antennæ 8-jointed, *without* a ring-joint or 9-jointed with a ring-joint, the pedicel not much longer than wide, the flagellum subcompressed; body striped or banded with black lines; wings banded or maculate .... **Zagrammosoma** Ashmead n. n. (type *Hippocephalus multilineata* Ashm.).
9. Antennæ 8-jointed or less 10
   Antennæ 9-jointed or more 12
10. Funicle 3-jointed, the club 3-jointed 11
    Funicle 2-jointed, the joints subpedunculate, the club ovate, 3-jointed.
    Middle lobe of the mesonotum longer than wide; metathorax very short, the apical lateral angles subacute; abdomen oblong-oval, depressed .... **Scotolinx** Ashmead, gen. nov. (type *S. gallicola* Ashm.).
11. Mesonotum a little *longer* than wide; abdomen conic-ovate .... **Olynx** Förster (type *Ichneumon gallarum* L.).
    Mesonotum a little *wider* than long; abdomen oval or ovate .... **Parolynx** Ashmead (type *P. lineatifrons* Ashm.).
12. Antennæ 10-jointed, with *one* ring-joint 13

Antennæ 9-jointed, with *one* ring-joint.

Non-metallic, usually yellowish, or the thorax more or less yellow; scutellum with 4 bristles; pronotum campanulate; abdomen ovate or conic-ovate...... **Cirrospilus** Westwood (partim).

13. Metallic in part; mesonotum not longer than the scutellum; abdomen broadly rounded, depressed, and a little shorter than the thorax............. **Rhicnopelte** Förster (type *R. fulviventris* Förster).

Non-metallic; mesonotum long; abdomen elongate oval or ovate, usually pointed at apex and longer than the thorax......................... **Stenomesioidea** Ashmead, g. nov. (type *S. mellea* Ashm.).

14. Abdomen distinctly petiolate... 15

Abdomen sessile or subsessile... 17

15. Scutellum with *two* dorsal grooved lines.

Body neither metallic nor wholly black... 16

Body metallic or wholly black.

Antennæ 10-jointed, with *one* ring-joint........................... **Elachertus** Spinola.

16. Antennæ 10-jointed, with *one* ring-joint. **Cirrospiloideus** Ashmead.

17. Scutellum with *two* dorsal grooved lines.. 18

Scutellum *without* dorsal grooved lines... 21

18. Head normal, viewed from in front wider than long or rounded, not especially thin antero-posteriorly.. 19

Head abnormal, viewed from in front much *longer* than wide and very thin antero-posteriorly...... 20

19. Body not wholly metallic, the head and thorax marked with yellow.

Antennæ 9-jointed, with *one* ring-joint.............................. **Cirrospilus** Westwood.

Antennæ 10-jointed, with *one* ring-joint.......................... **Cirrospiloideus** Ashmead.

Body metallic; antennæ 10-jointed, with *one* ring-joint, the funicle 4-jointed...... **Elachertus** Spinola.

20. Antennæ 9-jointed with a ring-joint, body striped or banded with black lines; wings banded or maculate.. **Zagrammosoma** Ashmead.

21. Antennæ 8-jointed or less... 22

Antennæ 9-jointed or more... 24

22. Funicle 3-jointed... 23

Funicle 2-jointed... **Scotolinx** Ashmead.

23. Mesonotum *longer* than wide... **Olynx** Förster.

Mesonotum a little *wider* than long... **Paraolinx** Ashmead.

24. Antennæ 10-jointed, with *one* ring-joint.

Non-metallic... (?) genus.

Antennæ 9-jointed, with *one* ring-joint.

Metallic... **Rhicnopelte** Förster.

Non-metallic... **Cirrospilus** Westwood (partim).

Subfamily V. Eulophinæ.

1856. Eulophoidæ, Familie 19 (partim), Förster, Hym. Stud., II., pp. 19, 26 and 74.

1875. Eulophina, Tribus (partim), Thomson, Hym. Skand., V., p. 180.

1886. Eulophinæ, subfamily (partim), Howard, Ent. Amer., I., p. 198; II., p. 99.

To this subfamily are restricted all Eulophids having the mesonotum entire or only partially divided, the mesonotal furrows being at the most only indicated anteriorly; otherwise it resembles the others.

The species are parasites of the Micro-lepidoptera, and particularly the leaf-miners, although other groups are also attacked by them. Some are also said to be hyperparasites of other Chalcidoids.

Most of the species are very small, of brilliant metallic colors, and the antennæ in many males are ramose or branched.

Two tribes have been recognized:

TABLE OF TRIBES.

Hind tibiæ with 2 apical spurs...Tribe I. Eulophini.

Hind tibiæ with one apical spur...Tribe II. Hemiptarsenini.

Tribe I. *Eulophini.*

In having two apical spurs to the hind tibiæ this tribe agrees with the *Euplectrini* and the *Ophelinini*, in the subfamily *Elachertinæ*, but it cannot possibly be confused with these tribes, if attention is given to the difference pointed out in the mesonotum, the mesonotal furrows being *incomplete.*

TABLE OF GENERA.

1. Females.. 2

   Males.. 11

2. Scutellum with *two* dorsal grooved lines.. 3

   Scutellum *without* dorsal grooved lines.. 4

3. Antennæ inserted below the middle of the face.

   Head seen from in front longer than wide, or as long as wide; stigmal vein about half the length of the marginal vein; pronotum short, rounded anteriorly; abdomen ovate, depressed above; antennæ 8-jointed, with *one* ring-joint, the funicle *two*-jointed, the club long, 3-jointed. **Diaulus** Ashmead, g. nov. (type *D. begini* Ashm.).

   Head seen from in front twice wider than long or nearly; stigmal vein long, nearly two thirds the length of the marginal vein; pronotum semicircular, not short, narrower than the mesonotum; abdomen ovate, depressed above, hardly as long as the thorax; antennæ 9-jointed, the flagellum subclavate, the funicle *four*-jointed.............. **Diaulomorpha** Ashmead, g. nov. (type *D. australiensis* Ashm.).

4. Antennæ inserted nearer the middle of the face, the scape long.................................. 5

   Antennæ inserted below the middle of the face.. 6

5. Thorax long, the pronotum long, conical and much narrower than the mesonotum, but fully as long; head wide, as wide as the thorax, seen from in front a little wider than long; antennæ 10-jointed, with *one* ring-joint, inserted a little below the middle of the face, the funicle 4-jointed, the joints long, the first much the longest, twice as long as the third, the fourth hardly longer than thick; wings with a discoidal cloud beneath the stigmal vein, the marginal vein very long, more than thrice the length of the stigmal...............**Notanisomorpha** Ashmead, g. nov. (type *N. collaris* Ashm.).

6. Marginal vein very long, three or more times longer than the stigmal vein........................ 7

   Marginal vein shorter, not thrice as long as the stigmal vein, usually only about twice as long..... 8

7. Antennæ 10-jointed, the flagellum more or less compressed, the joints long, the first joint of the funicle

much the longest joint; metathoracic spiracles oblong-oval; abdomen often very long, conically pointed, much longer than the head and thorax united........................**Sympiesis** Förster (type *Eulophus sericeicornis* Nees).

Antennæ 10-jointed, with *one* ring-joint, the flagellum not compressed, the funicle joints cylindrical; metathoracic spiracles minute, rounded; abdomen ovate or oval, depressed, not as long as the head and thorax united...............**Dimmockia** Ashmead,[1] g. nov. (type *Eulophus incongruus* Ashm.)

8. Thorax not robust 9

Thorax robust.

Metathorax with a median carina, the spiracles small, rounded; antennæ 9-jointed, with *one* ring-joint, the funicle 3-jointed, the club 3-jointed, abdomen oval or subrotund, depressed, usually shorter than the thorax...............**Cratotrechus** Thomson (type *Ichneumon larvarum* L.).

9. Wings hyaline, the flagellum not compressed.. 10

Wings dusky, the flagellum compressed, the funicle very short; metanotum with a median carina. **Microplectron** Thomson (type *Entedon fascipennis* Zeterstd.).

10. Antennæ 9-jointed (scape pedicel, *one* ring-joint, 3-jointed funicle and a 3-jointed club).

Funicle black; metanotum with a distinct median carina, the lateral folds usually present. **Eulophus** Geoffroy (type *Ichneumon pectinicornis* L.).

Funicle white; metanotum with a delicate median carina, the lateral folds always absent. **Microlycus** Thomson (type *M. heterocerus* Thoms.).

11. Scutellum *with* dorsal grooved lines 12

Scutellum *without* dorsal grooved lines 13

12. Thorax not long, the pronotum anteriorly rounded; antennæ inserted below the middle of the face, the flagellum without branches, filiform.

Stigmal vein not more than half the length of the marginal vein; antennæ 8-jointed. **Diaulus** Ashmead.

Stigmal vein longer, at least two thirds the length of the marginal vein; antennæ 9-jointed. **Diaulomorpha** Ashmead.

13. Thorax not long, the pronotum of normal length 14

Thorax long, the pronotum long, conical and much narrower than the mesonotum; antennæ 10-jointed, with one ring-joint ....**Notanisomorpha** Ashmead.

14. Marginal vein very long, three or more times longer than the stigmal vein........................ 15

Marginal vein shorter, not thrice as long as the stigmal vein 16

15. Antennæ 10-jointed, with one ring-joint.

Flagellum compressed or subcompressed; metathoracic spiracles oval or subovate; abdomen long. **Sympiesis** Förster.

Flagellum filiform, cylindrical; metathoracic spiracles small, round; abdomen oval. **Dimmockia** Ashmead.

16. Thorax not robust... 17

Thorax robust.

Metanotum with a median carina and lateral folds; antennæ 9-jointed with 3 *long* branches. **Cratotrechus** Thomson.

17. Wings clear hyaline; flagellum not compressed 18

Wings dusky; flagellum compressed; funicle with 3 *short* branches..........**Microplectron** Dalman.

18. Funicle with 3 *long* branches...**Eulophus** Geoffroy.

Funicle with 3 *short* branches...**Microlycus** Thomson.

[1] Named in honor of Dr. Geo. Dimmock.

Funicle with 2 long branches.................................... **Dicladocerus** Westwood.
Funicle with 5 long branches.................................... **Pentacladia** Westwood.

Tribe II. *Hemiptarsenini.*

The single-spurred hind tibiæ distinguish the tribe; otherwise it is not distinguishable from the preceding tribe.

The genera are not numerous and may be easily recognized by the characters made use of in the following table :

TABLE OF GENERA.

1. Females.. 2
   Males.. 5
2. Scutellum *without* dorsal grooved lines.. 3
   Scutellum *with* 2 dorsal grooved lines.
   Antennæ 8-jointed (scape, pedicel, one ring-joint, 2-jointed funicle and a 3-jointed club).
   Diglyphus Walker = *Solenotus* Först. (type *D. poppœa* Walk.).
3. Antennæ inserted *below* the middle of the face.................................. 4
   Antennæ inserted on the middle of the face.
   Antennæ 9-jointed (scape, pedicel, one ring-joint, 3-jointed funicle and 3-jointed club), the scape long, extended beyond the ocelli.... **Hemiptarsenus** Westwood (type *H. fulvicollis* Westw.).
4. Antennæ 9-jointed with 1 ring-joint, the funicle 3-jointed, cylindrical, the first joint the longest, the club 3-jointed.............................. **Necremnus** Thomson (type *Eulophus leucarthrus* Nees).
5. Scutellum *without* dorsal grooved lines.. 6
   Scutellum *with* 2 dorsal grooved lines.
   Antennæ 8-jointed, with a ring-joint.. **Diglyphus** Walker.
6. Antennæ inserted *below* the middle of the face, the scape not extending beyond the ocelli.......... 7
   Antennæ inserted *on* the middle of the face, the scape long, extending beyond the ocelli.
   Hemiptarsenus Westwood.
7. Antennæ 9-jointed, the first three joints of the funicle with a long branch...... **Necremnus** Thomson.

Family LXXII. TRICHOGRAMMIDÆ.

1846. Eulophidæ, Family II. (partim), Walker, List Chalc. Brit. Museum, I., p. 62.

1856. Trichogrammatoidæ, Family XXII., Förster, Hym. Stud., II., pp. 20, 26 and 87.

1897. Trichogrammatinæ, Underfam., Aurivillius, Entom. Tidsk., 18, p. 250.

Dr. Arnold Förster was the first to recognize this natural family, which is at once distinguished, from all other groups, by the tarsi being *3-jointed*, never more nor less.

It comes nearest to the Family *Eulophinæ*, where Westwood placed his genus *Trichogramma* in 1840, and apparently forms a connecting link between that family and the next, or the *Mymaridæ*.

In habits the group agrees with the *Mymaridæ*, all the species falling in it being egg-parasites.

Two subfamilies have been recognized:

TABLE OF SUBFAMILIES.

Wings *without* regular rows of hairs...Subfamily I. OLIGOSITINÆ.
Wings *with* regular rows of hairs.....................................Subfamily II. TRICHOGRAMMINÆ.

SUBFAMILY I. OLIGOSITINÆ.

In the arrangement of the pubescence of the wings this group resembles most closely the *Eulophinæ*, and many of the species, but for the *3-jointed tarsi*, could be easily mistaken for species in that family.

Only five genera have been described, but it is probable that very many more exist and will be discovered when more attention is given to rearing the egg-parasites of the different orders of insects.

TABLE OF GENERA.

1. Females 2
   Males 6
2. Antennæ 6- or 7-jointed with *one* ring-joint.. 3
   Antennæ 8-jointed with *one* ring-joint, the funicle 2-jointed.........**Asynacta** Förster (type unknown).
3. Antennæ 6-jointed. 5
   Antennæ 7-jointed, with a ring-joint.
   Ovipositor not prominent 4
   Ovipositor prominent, at least half the length of the long abdomen; eyes oval; pedicel obconical, more than twice longer than thick; flagellum fusiform, 4-jointed, the single funicle joint hardly separable from the club; wings rather narrow with a long marginal fringe.
   Prestwichia Lubbock (type *P. aquatica* Lubbock).
4. Funicle 1-jointed, the club 3-jointed.
   Front wings narrow, with a long marginal fringe.
   Front wings *without* a substigmal fascia; scape straight or clavate, the single funicle joint scarcely longer than thick; eyes oblong-oval; metanotum smooth, without a carina ....**Oligosita** Haliday (type *O. collina* Hal. (Walker).
   Front wings *with* a substigmal fascia; scape subclavate, arcuate, the single funicle-joint much longer than thick; eyes rounded; metanotum bicarinate.
   Westwoodella Ashmead, g. nov. (type *Oligosita subfasciata* Westw.).
   Front wings broad, with a short marginal fringe..........**Brachista** Haliday (type unknown).
5. ? new genus.
6. Antennæ 7-jointed or less, with *one* ring-joint.. 7
   Antennæ 8-jointed, with one ring-joint ....**Asynacta** Förster.
7. Fully winged.. 8
   Wingless or subapterous.
   Scape slender, pedicel obconical, about thrice as long as thick at apex, the flagellum fusiform

4-jointed, the single funicle joint hardly separable from the club, hind legs very long. **Prestwickia** Lubbock.

8. Funicle 4-jointed, the club one-jointed.
   Front wings with a *long* marginal fringe.
      Metanotum *without* carinæ.......................................**Oligosita** Haliday.
      Metanotum bicarinate.......................................**Westwoodella** Ashmead.
   Front wings with a short marginal fringe.......................................**Brachista** Haliday.

SUBFAMILY II. TRICHOGRAMMINÆ.

This subfamily is easily recognized by peculiarities of the front wings, the pubescence, being arranged in distinct rows or lines, a peculiarity found in no other group, except to a slight extent in some genera in the subfamily *Entedoninæ*, of the family *Eulophinæ*.

TABLE OF GENERA.

1. Females... 2
   Males... 10
2. Veins in front wings forming a regular arch....................................... 3
   Veins in front wings *not* forming a regular arch....................................... 4
3. Antennæ 8-jointed, the flagellum clavate, the funicle 2-jointed, the joints transverse.
   Body short, robust..............................**Poropœa** Förster (type *P. stollwerckii* Först.).
4. Antennæ 7-jointed or less... 5
   Antennæ 8-jointed (scape, pedicel, *one* ring-joint, a 2-jointed funicle and a 3-jointed club).
   Trichogramma Westwood (type *T. evanescens* Westw.).
5. Antennæ 6-jointed or less... 7
   Antennæ 7-jointed.
      Wings with a short marginal fringe... 6
      Wings with a long marginal fringe..............**Chætostricha** Haliday (type *C. dimidiata* Hal.).
6. Antennæ with the club 4-jointed (scape, pedicel, one ring-joint and a 4-jointed club).
   Lathromeris Förster (type *L. scutellaris* Först.).
7. Antennæ 3- or 6-jointed, *without* a ring-joint... 8
   Antennæ 6-jointed, *with* a ring-joint (scape, pedicel, one ring-joint, a 2-jointed funicle and a solid club).
      Abdomen shorter than the thorax.......**Xanthoatomus** Ashmead, gen. nov. (type *X.*).
      Abdomen subcylindrical, longer than the thorax..............................**Pentarthron** Riley (type *Trichogramma minutum* Riley).
8. Antennæ 3-jointed... 9
   Antennæ 6-jointed, the club 3-jointed (scape, pedicel, a 1-jointed funicle and a 3-jointed club).
      Postscutellum not distinct, *without* a triangular projection....................**Centrobia** Förster (type *Trichogramma Walkeri* Först.).
      Postscutellum distinct, *with* a triangular projection....................**Paracentrobia** Howard (type *P. punctata* How.).
9. Club not jointed.
      Marginal fringe not especially long, the marginal vein not more than twice as long as the stigmal vein.......................................**Aprobosca** Westwood.
10. Antennæ 7-jointed or less... 11
    Antennæ 8-jointed.

Veins of front wings forming a regular arch; flagellum filiform............ **Poropœa** Förster.

Veins of front wings not forming a regular arch.................... **Trichogramma** Westwood.

11. Antennæ 6-jointed or less.. 12

Antennæ 7-jointed.

Wings with a very long marginal fringe.................................. **Chætostricha** Haliday.

Wings with a short marginal fringe.

Club of antennæ 4-jointed... **Lathromeris** Förster.

Club of antennæ 3-jointed... **Pentarthron** Riley.

12. Antennæ 6-jointed (scape, pedicel, a 1-jointed funicle and a 3-jointed club), marginal vein about thrice as long as the stigmal... **Centrobia** Förster.

Antennæ 3-jointed (scape, pedicel and a long, solid club); marginal vein not more than twice the length of the stigmal vein..................... **Aprobosca** Westwood (type *A. erosicornis* Westw.).

Family LXXIII. MYMARIDÆ.

1833. Mymares, Tribus 5[ta], Haliday, Ent. Mag., I., p. 341.

1839. Mymaridæ, Family 17, Haliday, Hym. Syn., p. II.

1840. Mymarides, Subfamily 6 (Family Proctotrypidæ), Westwood, Intro. Mod. Class. Ins. Synop., p. 78.

1856. Mymaroidæ, Familie 28, Förster, Hym. Stud., II., pp. 20, 27 and 116.

1897. Mymaridæ, Family LXXIII., Ashmead, Proc. Ent. Soc. Washington, IV., p. 236.

This group was correctly defined by A. H. Haliday, first as a tribe and afterwards as a distinct family.

In 1833 in speaking of it he says: "This tribe comprises the very atoms of the order Hymenoptera. Their hues are mostly black or yellowish, unadorned by metallic splendor: the plumed and iridescent wings of many are beautiful objects for the microscope. The males, by their very long and slender antennæ (sometimes more than twice the length of the body), resemble Ichneumons in miniature."

Every species belonging to the family lives parasitically in the eggs of other insects, and in habits agree with the *Trichogrammidæ*.

Stephens, Curtis, Walker, Westwood, Förster, Thomson and most systematists treat the group as a component of the *Proctotrypoidea* and Dr. von Dalla Torre in his *Catalogus Hymenopterorum* follows these older authorities and treats it as a subfamily in the *Proctotrypidæ*. More than ten years ago I pointed out the structural characters that excluded the group from having any affinity with these insects; they are widely distinct in many particulars and form a compact natural family in the Chalcidoidea, as was first pointed out by Haliday so many years ago. My extensive studies into all groups of the Hymenoptera have only confirmed and emphasized the correctness and soundness of Haliday's views, the ablest systematist of his day, and his views should prevail.

Two subfamilies have been defined, separated by the number of joints in the tarsi.

TABLE OF SUBFAMILIES.

Tarsi 5-jointed..Subfamily I. GONATOCERINÆ.
Tarsi 4-jointed..Subfamily II. MYMARINÆ.

SUBFAMILY I. GONATOCERINÆ.

The subfamily is easily recognized by the longer tarsi which are always 5-jointed, never 4-jointed.

Two tribes may be distinguished by the following simple characters:

TABLE OF TRIBES.

Abdomen petiolate..Tribe I. Ooctonini.
Abdomen petiolate..Tribe II. Gonatocerini.

TRIBE I. *Ooctonini.*

TABLE OF GENERA.

1. Females.. 2
   Males.. 3
2. Antennæ 11-jointed.................**Ooctonus** Haliday (type *O. insignis* Hal.).
   Antennæ 9-jointed.................**Camptotera** Förster (type *C. papaveris* Först.).
3. Antennæ 13-jointed..**Ooctonus** Haliday.
   (?) **Palæomyrmar** Meunier (type *P. suecine* Meunier).
   Antennæ 10-jointed..**Camptotera** Förster.

TRIBE II. *Gonatocerini.*

The distinctly petiolated abdomon distinguishes the tribe.

TABLE OF GENERA.

1. Females.. 2
   Males.. 4
2. Antennæ more than 8-jointed.. 3
   Antennæ 8-jointed.
   Marginal vein long.................**Leimacis** Förster (type *L. rufula* Först.).
   Marginal vein short.................**Alaptus** Haliday (type *A. buscalus* Hal.).
3. Antennæ 9-jointed; marginal vein long.................**Litus** Haliday (type *L. cynipseus* Hal.).
   ? = *Malfattia* Meunier (type *M.molitoræ* Meun.).
   Antennæ 11-jointed; marginal vein short.................**Gonatocerus** Nees (type *G. longicornis* Nees).
4. Marginal vein short.. 5
   Marginal vein long.
   Antennæ 11-jointed..**Leimacis** Förster.
   Antennæ 13-jointed..**Litus** Haliday.
5. Antennæ 10-jointed..**Alaptus** Haliday.
   Antennæ 13-jointed..**Gonatocerus** Nees.

Subfamily II. Mymarinæ.

In this subfamily fall some of the smallest Hymenoptera known, hardly visible to the naked eye, and living parasitically in the eggs of some other small insect.

The group is distinguished by having the tarsi 4-jointed, not 5-jointed as in the *Gonatocerinæ*.

It is divided by the attachment of the abdomen into two tribes.

TABLE OF TRIBES.

Abdomen sessile or subsessile.......... Tribe I. Anaphini.
Abdomen distinctly petiolate .... Tribe II. Mymarini.

Tribe I. *Anaphini.*

The sessile abdomen distinguishes the tribe.

TABLE OF GENERA.

1. Females 2
   Males 4
2. Antennæ more than 8-jointed 3
   Antennæ 8-jointed .... **Anthemus** Howard (type *A. chionaspidis* How.).
3. Antennæ 9-jointed.
   Marginal vein lengthened .... **Anaphes** Haliday (type *A. fuscipennis* Hal.).
   Marginal vein not lengthened .... **Anagrus** Haliday (type *Ichneumon atomus* Linné).
4. Antennæ more than 9-jointed 5
   Antennæ 9-jointed .... **Anthemus** Howard.
5. Antennæ 12-jointed; marginal vein long .... **Anaphes** Haliday.
   Antennæ 13-jointed; marginal vein short .... **Anagrus** Haliday.

Tribe II. *Mymarini.*

In this tribe the abdomen is always distinctly petiolate, never sessile.

TABLE OF GENERA.

1. Females 2
   Males 7
2. Antennal club solid, unjointed 4
   Antennal club 2-jointed 3
3. Marginal vein long; tarsi short .... **Eustochus** Haliday (type *E. atripennis* Hal.).
   Marginal vein short; tarsi long .... **Doryclytus** Förster (type *D. vitripennis* Förster.
4. Marginal vein either lengthened or punctiform, but never wholly absent 6
   Marginal and other veins absent.
      Hind wings wanting or aborted; front wings neither spoon-shaped nor much broadened at apex, sometimes split into two parts 5
      Hind wings present, normal; front wings spoon-shaped; antennæ 9-jointed.
      Mymarilla Westwood (type *M. taprobanica* Westw.).

5. Front wings widened only at apex and with a long marginal fringe; antennæ 9-jointed.
Mymar Haliday (type *M. pulchellus* Hal.).
Front wings not wide, sometimes split at apex; antennæ apparently but 3-jointed.
Packardiella Ashmead (type *Pteratomus putmanii* Pack.).

6. Antennæ 9-jointed.
Marginal vein punctiform .... **Polynema** Haliday (type *Ichneumon ovulorum* Hal.).
Marginal vein lengthened.
Metanotum *without* a carina .... **Stichothrix** Förster (type *S. cardui* Först.).
Metanotum with *two* carinæ............... **Ceraphractus** Haliday (type *C. cinctus* Hal.).

7. Marginal vein punctiform or lengthened 9
Marginal vein and all others absent or wanting.
Front wings narrow, usually somewhat broader toward apex, or linear or split at apex; hind wings usually absent or aborted 8
Front wings broad, spoon-shaped; hind wings entire.
Antennæ 13-jointed.. **Mymarilla** Westwood.

8. Front wings not split at apex; antennæ 13-jointed .... **Mymar** Haliday.
Front wings linear or split at apex; antennæ (?) imperfect.................. **Packardiella** Ashmead.

9. Marginal vein lengthened... 10
Marginal vein punctiform.
Antennæ 13-jointed... **Polynema** Haliday.

10. Antennæ 10-jointed; metanotum smooth, without a carina .... **Stichothrix** Förster.
Antennæ 11-jointed; metanotum bicarinate .... **Ceraphractus** Förster.

Genera unknown to Author and not Classified.

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Zagrammosoma Ashmead, n. n. for *Hippocehalus* Ashm. preoc., ante, p. 354. (Type *H. multilineatus* Ashm.)

Zaomma Ashmead, Proc. U. S. Nat. Mus., XXII., 1900, p. 340. (Type *Encyrtus argentipes* How.)

Zaommomyia Ashmead, gen. nov., ante, p. 340. (Type *Chrysochris stigmata* Ashm.)

Zapachia Förster, Verh. d. naturh. Ver. pr. Rheinl., XXXV., 1878, p. 47. (Type *Z. spiloptera* Först.)

Zarhopalus Ashmead, Proc. U. S. Nat. Mus., XXII., 1900, p. 342. (Type *Z. sheldoni* Ashm.)

PART II. SOUTH AMERICAN CHALCIDOIDEA, WITH DESCRIPTIONS OF NEW SPECIES IN THE CARNEGIE MUSEUM.

Superfamily VII. *CHALCIDOIDEA.*

Family LX. AGAONIDÆ.

Subfamily I. Agaoninæ.

Genus BLASTOPHAGA Gravenhorst.

Blastophaga bifossulata Mayr.

Blastophaga bifossulata Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 181, ♂ ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 324.

Brazil: Blumenau (Dr. Fritz Müller).

Blastophaga brasiliensis Mayr.

Blastophaga brasiliensis Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 180, ♂ ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 324.

Brazil: Blumenau (Dr. Fritz Müller).

Genus TETRAPUS Mayr.

Tetrapus americanus Mayr.

Tetrapus americanus Mayr, Verh. Zoöl.-bot. Gesell., XXXV., 1885, p. 188, ♂ ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 323.

Brazil: Blumenau (Dr. Fritz Müller).

Genus EISENIA Ashmead.

Eisenia flaviscapa, sp. nov.

Female.—Length about 1 mm.; ovipositor as long as the abdomen and the thorax united. Head and thorax black, polished; hypopygium prominent, piceous; scape broadly dilated, about twice as long as wide, yellow, the pedicel and the flagellum dark brown, the process of the first funicle joint long and acute; legs brownish-yellow, the front and hind femora especially above brownish-piceous; wings hyaline, with short ciliæ at apex, the veins pale yellowish. The head is a little longer than wide, with a deep broad frontal furrow, the eyes oval; middle tarsi very slightly longer than their tibiæ.

Brazil: Para. One specimen.

Family LXI. TORYMIDÆ.

Subfamily I. Idarninæ.

Genus IDARNES Walker.

Idarnes brevicollis (Mayr).

Tetragonaspis brevicollis Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 209, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 320.

Brazil: St. Catharina (Dr. Fritz Müller).

Idarnes carme Walker.

Idarnes carme Walker, Ann. & Mag. Nat. Hist., XII., 1843, p. 47, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 317.

Tetragonaspis flavicollis Mayr, Verh. Zool.-bot. Gesell., 1885, p. 207, ♀.—Dalla Torre, Cat. Hym., V, 1898, p. 320.

Ganosoma robustum Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 204, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 321.

West Indies: Grenada, St. Vincent; Brazil: St. Catharina.

Idarnes coriaria (Mayr).

Tetragonaspis coriaria Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 209, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 320.

Brazil: St. Catharina (Dr. Fritz Müller).

Idarnes forticornis (Mayr).

Tetragonaspis forticornis Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 208, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 320.

Brazil: St. Catharina (Dr. Fritz Müller).

Idarnes gracilicornis (Mayr).

Ganosoma attenuatum Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 204, ♂.

Tetragonaspis gracilicornis Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 208, ♀.

Brazil: St. Catharina (Dr. Fritz Müller).

Idarnes parallela (Mayr).

Ganosoma parallelum Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 204, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 320.

Brazil: St. Catharina (Dr. Fritz Müller).

IDARNES PUNCTATA (Mayr).

Tetragonaspis punctata Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 209, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 320.

Brazil: St. Catharina (Dr. Fritz Müller).

Genus TRICHAULUS Mayr.

TRICHAULUS VERSICOLOR Mayr.

Trichaulus versicolor Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 226, ♀; T. 13, f. 38.—Fr. Müller, Kosmos, XVIII., 1886, pp. 54, 55.

Critogaster singularis Mayr, Verh. Zool.-bot. Gesell. Wien, XXXV., 1885, p. 200, ♂; T. 12, f. 24.—Fr. Müller, Kosmos, XVIII., 1886, pp. 54, 55.—Dalla Torre, Cat. Hym., V., 1898, p. 321.

Brazil: St. Catharina (Dr. Fritz Müller).

TRICHAULUS FLAVESCENS (Müller).

Critogaster flavescens Müller, Ent. Nachr., XIII., 1887, p. 161, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 321.

Brazil: Rio de Janeiro (Dr. Emil A. Göldi).

TRICHAULUS GÖLDIANA (Müller).

Critogaster göldiana Müller, Ent. Nachr., XIII., 1887, p. 161, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 321.

Brazil: Rio de Janeiro (Dr. Emil A. Göldi).

TRICHAULUS NUDA (Mayr).

Critogaster nuda Mayr, Verh. Zool.-bot. Gesell., XXXV., 1885, p. 201, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 321.

Brazil: St. Catharina (Dr. Fritz Müller).

TRICHAULUS PILIVENTRIS (Mayr).

Critogaster piliventris Mayr, Verh. Zool.-bot. Gesell. Wien, XXXV., 1885, p. 201, ♂; T. 12, f. 25.—Fr. Müller, Kosmos, XVIII., 1886, p. 55.—Fr. Müller, *op. cit.*, XIX., 1886, p. 54.—Dalla Torre, Cat. Hym., V., 1898, p. 321.

Brazil: St. Catharina (Dr. Fritz Müller).

Genus COLYOSTICHUS (Mayr).

COLYOSTICHUS LONGICAUDIS Mayr.

Colyostichus longicaudis Mayr, Verh. Zool.-bot. Gesell. Wien, XXXV., 1885, p. 239, ♀.

Heterandrium longipes Mayr, Verh. Zool.-bot. Gesell. Wien, XXXV., 1885, pp. 234–235, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 316, ♂♀.

Brazil: St. Catharina (Dr. Fritz Müller).

Subfamily II. Toryminæ.

Genus LOCHITES Förster.

Lochites auriceps Ashmead.

Lochites auriceps Ashmead, Journ. Linn. Soc. London, Zool., XX., 1894, p. 153, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 284.

W. I.: St. Vincent, Grenada; Brazil: Chapada, in April. Three specimens.

Lachites sulcius (Walker).

Callimome sulcius Walker, Monogr. Chalc., II., 1839, p. 64, ♀.

Torymus sulcius Dalla Torre, Cat. Hym., V., 1898, p. 313.

Brazil: Bahia; Chapada, in April. Three specimens.

Genus SYNTOMASPIS Förster.

Syntomaspis cabura (Walker).

Callimome caburus Walker, Monogr. Chalc., II., 1864, p. 64, ♀♂.

Torymus caburus Dalla Torre, Cat. Hym., V., 1898, p. 301.

Brazil: Bahia (Walker).

Syntomaspis aprilis, sp. nov.

Female.—Length 2.5 mm.; ovipositor nearly as long as the body. Blue, with a very faint greenish tinge, the abdomen with a decided æneous tinge. Head and thorax shagreened, with a thimble-like punctuation; ocelli pale; eyes brown; scape yellowish, the pedicel æneous, the flagellum dark brown; front and middle femora above and the hind femora blue, the front and middle tibiæ, their tarsi and the hind tarsi, yellowish, the hind tibiæ dark brownish. Wings hyaline, the tegulæ and veins yellowish.

Brazil: Carumba, in April. Two female species.

Syntomaspis holcaspoidea, sp. nov.

Female.—Length 2 mm.; ovipositor longer than the abdomen. Robust, blue, the head and the thorax with a thimble-like punctuation; ocelli red, placed nearly in a straight line; eyes brown; scape, pedicel, tips of front and middle femora, their tibiæ and tarsi and the hind tarsi, yellowish, the front and middle femora, except tips, and the hind tibiæ brownish-piceous, the hind femora blue; flagellum brown-black. Wings hyaline, the veins yellowish.

Male.—Length 1.2 to 1.5 mm. Agrees well with the ♀ in color and sculpture, except that the scape of the antennæ alone is yellow, the pedicel being æneous black. The abdomen is small, oval.

Brazil: Chapada, in April; Corumba, in May. Two female and two male specimens.

SYNTOMASPIS FLAVICOLLIS, sp. nov.

Female.—Length 2.6 mm.; ovipositor longer than the body. Bluish-green, the mesonotum posteriorly and the scutellum violaceous, the scape of antennæ, the prothorax, the legs, including coxæ, the tegulæ, venation of front wings, metapleura and the venter yellow or yellowish; the flagellum is brown-black; eyes very large, oval, brown. The head and the thorax are delicately shagreened, the scutellum with some sparse punctures beyond the apical cross-furrow. Wings hyaline, the veins pale yellowish.

Brazil: Chapada, in September. One female specimen.

Genus TORYMUS Dalman.

TORYMUS CUMELIS (Walker).

Callimome cumelis Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 114, ♀.—Spinola, Gay: Hist. fis. Cuba, Zool., VI., 1851, p. 464.

Torymus cumelis Dalla Torre, Cat. Hym., V., 1898, p. 308.

Chile: Valparaiso (Walker).

TORYMUS NONACRIS (Walker).

Callimome nonacris Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 113, ♀.—Spinola, Gay: Hist. fis. Chile, Zool., VI., 1851, p. 463, ♀.

Torymus nonacris Dalla Torre, Cat. Hym., V., 1898, p. 311.

Chile: Valparaiso, Walker; Brazil: Corumba, in April. One female specimen.

TORYMUS CHAPADÆ, sp. nov.

Female.—Length 2 mm.; ovipositor a little longer than the body. Head and thorax above greenish-blue, the pleura, metathorax, coxæ, femora and abdomen blue, the scape, tibiæ and tarsi yellowish, the flagellum brown-black, the ocelli pale, the eyes brown. The head, thorax and scutellum are shagreened. Wings hyaline, the tegulæ and veins pale yellowish. The abdomen is very short, higher than long, but this may be due to an accident.

Brazil: Chapada, highlands, in April. One female specimen.

TORYMUS SMITHI, sp. nov.

Female.—Length 3 mm.; ovipositor longer than the body. Blue, the head and thorax with a thimble-like punctuation, the tip of the scutellum smooth and

metallic green; the scape, tegulæ, veins and most of the legs, except the coxæ and the femora, are yellowish, the coxæ and the hind femora are blue, the front and middle femora above and basally are brownish.

Brazil: Chapada, in April; Para, in June. Two female specimens.

Torymus sylvicola, sp. nov.

Female.—Length 8 mm.; ovipositor about the length of the body. Head and thorax metallic green, rather coarsely shagreened, the metathorax blue, the abdomen æneous, with a brownish shade; scape and pedicel yellowish, the flagellum light brown; legs, except the hind coxæ at basal two thirds which are metallic greenish, all brownish-yellow. Wings hyaline, the tegulæ and the veins pale yellowish.

Brazil: Chapada, in forests in April and October. Two specimens.

Subfamily III. Monodontomerinæ.

Genus MONODONTOMERUS Westwood.

Monodontomerus phormio (Walker).

Torymus phormio Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 113, ♀.—Spinola, Gay: Hist. fis. Chile, Zool., VI., 1851, p. 466.—Dalla Torre, Cat. Hym., V., 1898, p. 311.

Monodontomerus phormio Walter, Notes on Chalc., II, p. 28.

Chile: Valparaiso.

Genus DIAMORUS Walker.

This genus should occur in South America, but I have seen no representatives of it in any of the collections examined by me. The species recorded and described by Dr. Mayr as *Diamorus* resemble genuine species very closely, but they really represent the females of Mayr's genus *Physothorax.*

Genus PHYSOTHORAX Mayr.

Physothorax annuliger Mayr.

Physothorax annuliger Mayr, Verh. Zool.-bot. Gesell. Wien, XXXV., 1885, p. 198, ♂.—Dalla Torre, Cat. Hym., V, 1898, p. 321.

Brazil: St. Catharina.

Physothorax biarticulatus (Mayr).

Nannocerus biarticulatus Mayr, Verh. Zool.-bot. Gesell. Wien, XXXV., 1885, p. 196, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 321.

Brazil: St. Catharina.

PHYSOTHORAX VARIABILIS (Mayr).

Diamorus variabilis Mayr, Verh. Zool.-bot. Gesell. Wien, XXXV., 1885, p. 228, ♀. —Dalla Torre, Cat. Hym., V., 1898, p. 291.

Physothorax dorsiger Mayr, Verh. Zool.-bot. Gesell. Wien, XXXV., 1885, p. 197 (wingless ♂).—Dalla Torre, Cat. Hym., V., 1898, p. 321.

PHYSOTHORAX MAYRI, sp. nov.

Female.—Length, 2.6 mm.; ovipositor about as long as the body. Similar to *P. variabilis* Mayr, but the punctures of the head and thorax are not so close, the scape and the pedicel being yellow, the prothorax being wholly blue, not all yellow or in part, as in *P. variabilis*, the femora, except at tips, being mostly blue, while the front wings have a brownish fascia beneath the stigmal vein, a character found in no other species.

Brazil.

Genus PLESIOSTIGMA Mayr.

PLESIOSTIGMA BICOLOR Mayr.

Plesiostigma bicolor Mayr, Verh. Zool.-bot. Gesell. Wien, XXXV, 1885, p. 227, ♂; Taf. XIII., f. 39, 40.—Dalla Torre, Cat. Hym., V., 1898, p. 316.

Brazil: Blumenau (Dr. Fritz Müller).

PLESIOSTIGMODES Ashmead, gen. nov.

This genus differs from all the other genera in the subfamily by the much swollen front femora, by the very long pronotum, which is longer than the mesonotum, and by the antennæ having *two* ring-joints.

PLESIOSTIGMODUS BRASILIENSIS, sp. nov.

Female.—Length 1.5 mm. Head bluish æneous, with some minute punctures, the thorax more decidedly æneous, with a decidedly metallic greenish tinge on the mesonotum and on the scutellum, and with some sparse, minute punctures; the thickened front and hind femora are also more or less greenish, the rest of the legs, except the coxæ, and the scape of the antennæ being yellowish, the pedicel and the flagellum brown-black; the abdomen, except a bluish tinge basally, is æneous black; it is sessile, oblong and tapers off at apex, the first segment being the longest and having a slight median incision at apex. Wings hyaline, the tegulæ and veins pale yellowish.

Brazil: Corumba, lowland in May. One specimen.

HEMITORYMUS Ashmead, gen. nov.

This genus is allied to *Cryptopristus* Förster, but is easily separated by the hind femora being feebly serrate, *without* a distinct tooth, and by the venation in the front wings which agrees with *Torymus* and is quite different from *Cryptopristus*.

HEMITORYMUS THORACICUS, sp. nov.

Female.—Length 4 mm., ovipositor much longer than the body. Head and metathorax metallic greenish, the metapleura blue, the rest of the thorax, the antennal scape and pedicel, the legs, except the hind coxæ at base behind and the venter, yellow; the abdomen above is more or less tinged with brown; the flagellum is long brown-black. The head and the thorax are shagreened and have a shallow thimble-like punctuation. The metathorax is smooth with distinct spiracular sulci, the spiracles being large, oblong-oval. The wings are hyaline, with the tegulæ and the veins pale yellowish. The abdomen is oblong, as long as or a little longer than the head and the thorax united, and subcompressed along the venter basally.

Brazil: Chapada, in September. One specimen.

SUBFAMILY V. MEGASTIGMINÆ.

Genus MEGASTIGMUS Dalman.

I have seen a single specimen of this genus taken in Brazil not in good condition. It ought to be well represented in South America.

SUBFAMILY VI. ORMYRINÆ.

Genus ORMYRUS Westwood.

ORMYRUS BRASILIENSIS, sp. nov.

Female.—Length 1.7 mm. Blue; ocelli red; the extreme base of the scape, the trochanters, knees, tips of the tibiæ and the tarsi, pale yellowish, the rest of the tibiæ brownish piceous; wings hyaline, the veins light brownish.

The head and the thorax are almost smooth, but under a strong lens exhibit five transverse aciculations. The third body segment of the abdomen has two transverse rows of punctures at base, the fourth has three rows, the punctures on the fifth are large and arranged in about four rows, while the sixth has an indistinct row at the extreme base.

Brazil: Chapada, in April. One specimen. This is the first species to be described from South America.

SUBFAMILY IV. PODAGRIONINÆ.

Genus PODAGRION Spinola.

PODAGRION BRASILIENSIS Howard.

Podagrion brasiliensis Howard, Journ. Linn. Soc. London, Zool., XXV., 1896, p. 83, ♀.—Howard, Journ. Linn. Soc. London, Zool., XXVI., 1897, p. 132.—Dalla Torre, Cat. Hym., V., 1898, p. 369.

Brazil: Santarem; Chapada. West Indies: Grenada.

Podagrion melleus (Westwood).

Palmon melleus Westwood, Trans. Ent. Soc. London, IV., 1847, p. 260.
Podagrion melleus Walker, Notes on Chalc., Pt. 2, 1871, p. 28.—Dalla Torre, Cat. Hym., V., 1898, p. 369.

Brazil.

Host. Orthop.: eggs of *Mantis brasiliana* L.

Podagrion cyaneus, sp. nov.

Female. — Length about 3 mm. Blue (sometimes bronzed green above); the antennæ, except the club which is black, the legs, except the coxæ basally and the front and hind femora at basal two thirds which are blue, the abdomen along the venter and at apex, are yellowish. Wings hyaline, the tegulæ yellow, the veins light brown. The flagellum is long, strongly clavate, while the swollen hind femora are armed with from ten to twelve teeth.

Brazil: Santarem. One specimen.

Differs from *P. brasiliensis* Howard in color and by the more numerous teeth on the hind femora.

Family LXII. CHALCIDIDÆ.

Subfamily I. Leucospidinæ.

Genus POLISTOMORPHA Westwood.

Polistomorpha fasciata Westwood.

Polistomorpha fasciata Westwood, Thes. Ent. Oxon., 1874, p. 134; Pl. XXV., f. 3.—Dalla Torre, Cat. Hym., V., 1898, p. 405.

Brazil: Amazon.

Polistomorpha sphegoides Walker.

Polistomorpha sphegoides Walker, Journ. Ent., I., 1860–61, p. 22.—Westwood, Thes. Ent. Oxon., 1874, p. 134; Pl. XXV., fig. 1.—Schletterer, Berlin. ent. Zeitschr., XXV., 1890, p. 297.—Dalla Torre, Cat. Hym., V., 1898, p. 405.

Brazil.

Polistomorpha surinamensis Westwood.

Polistomorpha surinamensis Westwood, Germar, Zeitsch. f. Entom., I., 1839, p. 265, ♀.—Westwood, Thes. Ent. Oxon, 1874, p. 133; Pl. XXV., f. 2.—Schletterer, Berlin. ent. Zeitschr., XXV., 1890, p. 295.—Dalla Torre, Cat. Hym., V., 1898, p. 405.

Brazil: Surinam.

Genus LEUCOSPIS Fabricius.

Leucospis affinis Say.

Leucospis affinis Say, Keating's Narrat. Exped., II., 1824, App., p. 327, ♀♂.—Leconte's Ed. Say's Works, I., 1859, p. 220.—Cresson, Trans. Am. Ent. Soc., IV., 1872, p. 32.—Provancher, Natur. Canad., XII., 1881, p. 268, ♀; fig. 12.—Provancher, Faun. ent. Can. Hym., 1883, p. 567; fig. 83.—Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, pp. 172, 175, 285.—Dalla Torre, Cat. Hym., V., 1898, p. 406.

Leucospis subnotata Westwood, Ent. Mag., II., 1834, p. 215, ♀.—Westwood, Zeitschr. f. Ent., I., 1839, p. 250.

Leucospis fraterna Say, Journ. Bost. Soc. Nat. Hist., I., 1836, p. 269.—Leconte's Ed. Say's Works, I., 1859, p. 718.

Leucospis duræi Westwood, Zeitschr. f. Ent., I., 1839, p. 251, ♀.

Leucospis basalis (Klug) Westwood, Zeitschr. f. Ent., I., 1839, p. 264.

Leucospis pœyi Guerin, Iconogr. régn. anim., VII., Ins., 1845, p. 414, ♀.—La Sagra's Hist. fis. Cuba, VII., 1850, p. 754.—Cresson, Proc. Ent. Soc. Phila., IV., 1865, p. 177.—Cresson, Trans. Am. Ent. Soc., IV., 1872, p. 32.

Leucospis canadensis Walker, Journ. Entom., I., 1860, p. 17.

Leucospis tapayosa Walker, Journ. Entom., I., 1860, p. 21.

Brazil (*teste* Schletterer).

Leucospis cayennensis (Westwood).

Metallopsis cayennensis Westwood, Germar's Zeitschr. f. Entom., I., 1839, p. 264, ♂; T. 4, f. 4.

Leucospis mexicana Walker, Journ. Entom., I., 1860, p. 20, ♀.—Cresson, Trans. Am. Ent. Soc., IV., 1872, p. 30.—Cameron, Biol. Centr.-Amer. Hym., I., 1883, p. 76; Pl. 4, f. 11.

Leucospis tomentosa Kirby, Journ. Linn. Soc. London, Zool., XVII., 1882, p. 70, ♀.

Leucospis cayennensis Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, pp. 172, 174 and 265; Pl. 6, f. 24.—Dalla Torre, Cat. Hym., V., 1898, p. 407.

Brazil.

Leucospis coxalis Kirby.

Leucospis coxalis Kirby, Ann. & Mag. Nat. Hist. (5), XV., 1885, p. 243, ♀.—Waterhouse, Aid Idend. Ins., Pt. XXVII., 1886; Pl. 169, f. 1, ♂.—Schletterer, Berlin. ent. Zeitschr., XXV., 1890, p. 271.—Dalla Torre, Cat. Hym., V., 1898, p. 407.

Argentina: Buenos Aires.

LEUCOSPIS CUPREOVIRIDIS Westwood.

Leucospis cupreoviridis Westwood, Thes. Ent. Oxon., 1874, p. 135; Pl. XXV., f. 5.—Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, p. 261.—Dalla Torre, Cat. Hym., V., 1898, p. 408.

New Grenada.

LEUCOSPIS DISTINGUENDA Schletterer.

Leucospis distinguenda Schletterer, Berlin. Ent. Zeitschr., XXXV., 1890, pp. 172 and 269, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 408.

Brazil.

LEUCOSPIS EGAIA Walker.

Leucospis egaia Walker, Journ. Entom., I., 1860, p. 20, ♀.—Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, p. 273.—Dalla Torre, Cat. Hym., V., 1898, p. 409.

Brazil: Ega.

LEUCOSPIS HOPEI Westwood.

Leucospis hopei Westwood, Ent. Mag., II., 1834, p. 215, ♂.—Westwood, Germar's Zeitschr. f. Ent., I., 1839, p. 258; T. 2, f. 3.—Spinola, Gay: Hist. fis. Chile, Zool., VI., 1851, p. 470; T. 4, f. 3.—Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, pp. 171, 174 and 280; T. 6, f. 22.

Chile.

LEUCOSPIS IGNOTA Walker.

Leucospis ignota Walker, Journ. Entom., I., 1860, p. 22, ♂.—Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, p. 289.—Dalla Torre, Cat. Hym., V., 1898, p. 411.

Brazil?

LEUCOSPIS LEUCOTELUS Walker.

Leucospis leucotelus Walker, Ann. & Mag. Nat. Hist. (2), IX., 1852, p. 41, ♀.—Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, pp. 172 and 274.—Dalla Torre, Cat. Hym., V., 1898, p. 412.

Brazil: Para.

LEUCOSPIS PROPINQUA Schletterer.

Leucospis propinqua Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, pp. 171 and 277, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 413.

Brazil.

LEUCOSPIS SANTAREMA Walker.

Leucospis santarema Walker, Journ. Entom., I., 1860, p. 20, ♀.—Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, p. 279.—Dalla Torre, Cat. Hym., V., 1898, p. 413.

Brazil: Santarem.

LEUCOSPIS SPEIFERA Walker.

Leucospis speifera Walker, Journ. Entom., I., 1860, p. 21, ♀.—Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, p. 272.—Dalla Torre, Cat. Hym., V., 1898, p. 413.

Brazil: Ega.

LEUCOSPIS ENDERLEINI, sp. nov.

(Plate XXXI., Fig. 1.)

Female.—Length 7 mm.; ovipositor short, not extending to the base of the third abdominal segment. Color dull bronze, the head in front and the pleura bronzy green, with whitish hairs; a streak at sides, along the front margin and along the hind margin of the pronotum, yellow or yellowish, another streak along the sides of the mesonotum and along its hind margin just in front of the scutellum, and a yellow band along the hind femora above and beneath, and along the outer face of the hind tibiæ.

The abdomen at the apex of the short second segment, the apex of the long third segment, and on the apical segments is metallic greenish and clothed with glittering white hairs.

Brazil: Santarem in March. One female. Named in honor of Dr. Günther Enderlein.

This species is allied to *L. cayennensis* Westw.

Genus EXOCHLÆNUS Shipp.

EXOCHLÆNUS ANTHIDIOIDES (Westwood).

Leucospis anthidioides Westwood, Thes. Ent. Oxon., 1874, p. 135; pl. 25, f. 7.—Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, p. 257.

Exochlœnus anthidioides Shipp, The Entom., XXVII., 1894, p. 245.—Dalla Torre, Cat. Hym., V., 1898, p. 404.

Brazil.

SUBFAMILY II. CHALCIDINÆ.

TRIBE I. *Chalcidini.*

Genus PHASGONOPHORA Westwood.

PHASGONOPHORA BATESII Kirby.

Phasgonophora batesii Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 74, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 371.

Brazil: Santarem.

PHASGONOPHORA CAUDATA (Sichel).

Conura caudata Sichel, Blanchard, Hist. Nat. Ins., III., 1840, p. 256.

Chalcis caudatus Guérin, Iconogr. régn. Anim., VII., 1845, Ins., p. 413; tab. 67, f. 6.

Phasgonophora caudata Sichel, Ann. Soc. ent. France (4), V., 1865, pp. 358 and 371, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 371.

Brazil.

PHASGONOPHORA CONDALUS Walker.

Phasgonophora condalus Walker, Entom., I., 1841, p. 134, ♀.—Sichel, Ann. Soc. ent. France (4), V., 1865, pp. 358 and 365.—Dalla Torre, Cat. Hym., V., 1898, p. 371.

Phasgonophora caudatus Guérin, Iconogr. régn. Anim., VII., 1845, Ins., p. 413 (def. typogr.).

Phasgonophora thoracica Sichel, Ann. Soc. ent. France (4), V., 1865, pp. 358 and 365.

Brazil (Mr. Curtis' collection).

Genus TRIGONURA Sichel.

TRIGONURA DORSALIS, sp. nov.

Female.—Length 7.4 mm. Entirely black, except the pronotum, the mesonotum and the scutellum which are red, and the front and middle knees, tips of tibiæ, and all the tarsi which are yellow. Wings hyaline, the tegulæ yellow, the veins brown

Brazil: Santarem. Three specimens.

TRIGONURA DENTIPES (Fabricius).

Chalcis dentipes Fabricius, Syst. Piez., 1804, p. 165.—Dalla Torre, Cat. Hym., V., 1898, p. 387.

South America.

Genus THAUMATELIA Kirby.

THAUMATELIA SEPARATA (Walker).

Chalcis separata Walker, Trans. Ent. Soc. London (3), I., 1862, p. 352, ♀.

Thaumatelia separata Kirby, Journ. Linn. Soc. London, XVII., 1883, p. 60; pl. 4, f. 9, 10.—Dalla Torre, Cat. Hym., V., 1898, p. 372.

Brazil: Ega.

THAUMATELIA PULCHRIPENNIS, sp. nov.

(Plate XXXI., Fig. 2.)

Female.—Length 15 mm. Black; the abdomen, except the long stylus which is black, rufous; legs, except the hind femora which are rufous, black, the knees and tarsi, except the middle and hind pairs basally, honey-yellow. Wings with the apical half fuscous, the basal half yellowish and a large yellowish spot at tip of marginal vein, within the space formed by the postmarginal and stigmal veins. The seventh abdominal segment and the stylus basally are coarsely pitted or punctate. The antennæ are long, filiform, the first joint of the flagellum being longer

than the scape. The hind femora are armed with 7 moderate-sized teeth. The head and thorax, except the pronotum laterally, the middle lobe of the mesonotum and the mesopleura beneath the insertion of the front wings, which are smooth and shining, with only a few punctures, are closely punctate or sculptured.

Brazil: Chapada, Para, and Santarem. Five specimens.

Genus PSEUDOCHALCIS Kirby.

PSEUDOCHALCIS DECLARATOR (Walker).

Halticella declarator Walker, Trans. Ent. Soc. London (3), I., 1862, p. 360, ♀.

Pseudochalcis declarator Kirby, Journ. Linn. Soc. London, XVII., p. 61.—Dalla Torre, Cat. Hym., V., 1898, p. 394.

Brazil: Ega.

PSEUDOCHALCIS CONICA sp. nov.

Female.—Length 4.5–5 mm. Black, coarsely punctate, the tegulæ, tips of femora, the front tibiæ, except a black spot behind, middle and hind tibiæ, except a broad black annulus at the middle, and all tarsi sulphur yellow, the abdomen conically pointed, longer than the head and thorax united.

Brazil: Santarem, in March and May. Four specimens.

PSEUDOCHALCIS FLAVOPICTA, sp. nov.

Male.—Length 5.5 mm. Black, coarsely punctate, the front orbits, face below insertion of the antennæ, scape, two large spots on dorsum of pronotum, a line on each side of the middle mesothoracic lobe, a spot on the outer front angle of the lateral lobes, a line on each side of the scutellum, the tegulæ, a line on the mesopleura, a large spot on the metapleura, a spot at apex of metanotum, a large spot on each side of second segment of abdomen, and the legs, except as noted, yellow, the hind coxæ with a large spot above at base, and a large spot on the disk of the hind femora, black.

Brazil: Corumba and Santarem. Three specimens.

Genus STYPIURA Kirby.

STYPIURA CONIGASTRA (Perty).

Chalcis conigastra Perty, Delect. anim. artic., 1834, p. 134; Pl. XXVI., f. 16.—Spinola, Mem. accad. sc. Torino (2), XIII., 1851, p. 44.

Conura conigastra Blanchard, Hist. nat. Ins., III., 1840, p. 256.

Halticella erythrotelus Walker, Journ. Entom., I., 1861, p. 184.

Phasgonophora conigastra Sichel, Ann. Soc. ent. France (4), V., 1865, p. 363.

Stypiura conigastra Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 59.—Dalla Torre, Cat. Hym., V., 1898, p. 395.

Brazil: Amazon; Santarem. One specimen.

Genus EPITELIA Kirby.

Epitelia aculeata (Walker).

Chalcis aculeata Walker, Journ. Entom., I., 1861, p. 184, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 385.

Brazil: Santarem. Four specimens.

Epitelia basalis (Walker).

Halticella basalis Walker, Trans. Ent. Soc. London (3), I., 1862, p. 361, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 397.

Brazil: Santarem. Three specimens.

Epitelia stylata (Walker).

(Plate XXXI., Fig. 3.)

Chalcis stylata Walker, Journ. Entom., I., 1861, p. 183, ♀.

Epitela stylata Kirby, Journ. Linn. Soc. London, XVII., 188.—Dalla Torre, Cat. Hym., V., 1898, p. 395.

Brazil: Santarem. One specimen.

Genus CHALCIS Fabricius.

Chalcis annulata Fabricius.

Chalcis annulata Fabricius, Syst. Ent., II., 1793, p. 197.—Syst., Piez., 1804, p. 167.—Lamarck, Hist. nat. anim. s. vert., IV., 1817, p. 153.—Id., Ed. 2ª, IV., 1835. p. 363.

Brachmyeria annulata Blanchard, Hist. nat. Insect., III., 1835, p. 393.

Chalcis annulatus Howard, Journ. Linn. Soc. London, Zool., XXV., 1894, p. 80, ♀♂.—Dalla Torre, Cat. Hym., V., 1898, p. 380.

Chalcis annulipes Walker, Ent. Mag., II., 1834, p. 29.

Chalcis ovata Say, Keating's Narrat. Exped., II., 1824, p. 326.—Leconte, Ed. Say's Works, I., 1859, p. 219.—Cresson, Trans. Am. Ent. Soc., IV., 1872, p. 59.—Litner's First Rep. Ins., New York, 1882, p. 86.—Cameron, Biol. Centr. Amer. Hym., I., 1884, p. 99; Pl. 4, f. 16.—Provancher, Add. Fn. du Canada, Hym., 1887, p. 190.

Leucospis integra Haldemann, Proc. Acad. Nat. Sci. Phila., II., 1844, p. 53, ♂.—Cresson, Trans. Am. Ent. Soc., IV., 1872, p. 35.—Schletterer, Berlin. ent. Zeitschr., XXXV., 1890, p. 291.—Dalla Torre, Cat. Hym., V., 1898, p. 411.

Chalcis incerta Cresson, Proc. Ent. Soc. Phila., IV., 1865, p. 101.
Brachymeria panamensis Holmgren, Eugenies Resa Ins., 1868, p. 437.
Chalcis flavipes Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 68.—Howard, in Scudder's Butterflies U. S., 1889, p. 1886; Pl. 88, figs. 14 and 15.

North and South America.

CHALCIS AUGARUS Walker.

Chalcis augarus Walker, The Entom., I., 1841, p. 134, ♀♂.—Dalla Torre, Cat. Hym., V., 1898, p. 386.

Brazil (Mr. Curtis' collection).

CHALCIS DECRETA Walker.

Chalcis decreta Walker, Trans. Ent. Soc. London (3), I., 1862, p. 352, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 381.

Brazil: Santarem (Bates); Chapada, March.

CHALCIS EURYTOMOIDES Walker.

Chalcis eurytomoides Walker, Trans. Ent. Soc. London (3), II., 1864, p. 207, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 387.

Brazil: Amazon (Bates).

CHALCIS FERRUGINEA Fabricius.

Chalcis ferruginea Fabricius, Syst. Piez., 1804, p. 165.—Dalla Torre, Cat. Hym., V., 1898, p. 387.

Brazil.

CHALCIS FERVIDA Walker.

Chalcis fervida Walker, Ann. & Mag. Nat. Hist. (2), IX., 1852, p. 42, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 387.

Brazil: Para.

CHALCIS IMPLEXA Walker.

Chalcis implexa Walker, Trans. Ent. Soc. London (3), I., 1862, p. 352, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 388.

Brazil: Ega (Bates); Santarem; Corumba (many specimens).

CHALCIS MINUTA (Linné).

Vespa sp. Geoffroy, Hist. abr. Insect., II., 1762, p. 380.
Vespa minuta Linné, Syst. nat., Ed. 12ª, I., 1867, p. 952.—Ph. L. Müller, Linnéa Vollst. Natursyst., V., 2, 1775, p. 887.—Villers, C. Linnæi Entom., III., 1789: p. 272.—Christ, Naturg. d. Insect., 1791, p. 246

Vespa femoralis Fourcroy, Entom. Paris, II., 1785, p. 437.
? Sphex femoralis Christ, Naturg. d. Insect., 1791, p. 291.
Chalcis femorata Dalman, Svensk. Vet.-Akad. Handl., XLI., 1820, p. 143, ♂ [excl. ♀].—Nees, Hym. Ichn. affin. Monogr., II., 1834, pp. 28 and 413 [excl. synon.].—Thomson, Hym. Skand., IV., 1875, p. 18, ♀♂.
Ichneumon minutus Coquebert, Illustr. iconogr. Insect., I., 1799, p. 19; T. 4, f. 7.
Brodymeria minuta Westwood, Phil. Mag. (3), I., 1832, p. 127.—Blanchard, Hist, nat. Ins., III., 1840, p. 255.—Westwood, Intro. mod. Class. Ins. Synop., p. 66.
Chalcis minuta Fabricius, Mant. Insect., I., 1787, p. 273.—Gmelin, Linné, Syst. nat., Ed. 13ª, 1790, p. 2742.—Olivier, Encycl. méthod. Ins., V., 1790, p. 439.—Rossi, Fauna Etrusca, II., 1790, p. 58, .♀—Fabricius, Ent. Syst., II., 1793, p. 195.—Panzer, Faun. Insect. German., III., 1796, p. 19; T. 4, f. 7.—Walckenaer, Faun. Paris, II., 1802, p. 77.—Schrökenstein, Verz. d. Halbkäfer, etc., 1802, p. 30.—Fabricius, Syst. Piez., 1804, p. 165.—Latreille, Hist. nat. Crust. et Ins., XIII., 1805, p. 220.—Panzer, Krit-Revis., II., 1806, p. 98.—Illiger, Rossi: Fauna Etrusca, Ed. 2ª, II., 1807, p. 87.—Jurine, Nouv. méth. class. Hym., 1807, p. 315, ♀.—Latreille, Gen. Crust. & Ins., IV., 1809, p. 26.—Spinola, Ann. Mus. hist. nat., XVII., 1811, p. 147.—Lamarck, Hist. nat. anim. s. vert., IV., 1817, p. 153.—Fouscolombe, Ann. Sc. Nat., XXVI., 1832, p. 277.—Audouin, Hist. nat. Insect. Mus., 1842, p. 183, ♂; T. 18, fig. 5.—Blanchard, Cuvier: Règne anim., Ed. 3ª, Insect., II., 1849; T. 113, f. 5.—Spinola, Gay; Hist. fis. de Chile, Zool., VI., 1851, p. 468, ♀♂.—Duméril, Mém. acad. sc. Paris, XXXI., 1860, p. 959.—Disconzi, Entom. Vicent., 1865, p. 134; T. 9, f. 154.—Ed. André, Ann. Soc. ent. France (6), I., 1881; T. 9, f. 5.—S. Saunders, Trans. Ent. Soc. London, 1881, Proc., p. xxiv.—Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 65; Pl. 4, f. 45 and 46.—Dalla Torre, Cat. Hym., V., 1898, p. 390.

Europe; North and South America.

CHALCIS MNESTOR Walker.

Chalcis mnestor Walker, The Entom., I., 1841, p. 219.—Dalla Torre, Cat. Hym., V., 1898, p. 390.

Brazil.

CHALCIS ORSEIS Walker.

Chalcis orseis Walker, The Entom., I., 1842, p. 338, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 390.

Brazil (Mr. Shuckard's collection).

CHALCIS PRODUCTA Olivier.

Chalcis producta Olivier, Encycl. Méthod. Ins., V., 1790, p. 438.—Dalla Torre Cat. Hym., V., 1898, p. 391.

Brazil: Cayenne.

? CHALCIS QUADRIPUNCTATA Fabricius.

Chalcis quadripunctata Fabricius, Syst. Piez., 1804, p. 165.—Dalla Torre, Cat. Hym., V., 1898, p. 392.

Brazil.

? CHALCIS SERRIPES Fabricius.

Chalcis serripes Fabricius, Syst. Piez., 1804, p. 164.—Dalla Torre, Cat. Hym., V., 1898, p. 392.

Brazil (Mr. Shuckard's collection).

? CHALCIS SUBFASCIATA Holmgren.

Chalcis subfasciata Holmgren, Eugenies Resa, Ins., 1868, p. 436, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 393.

Argentina: Buenos Ayres.

CHALCIS TESTACEA Blanchard.

Chalcis testacea Blanchard, Hist. nat. Ins., III., 1840, p. 254.—Dalla Torre, Cat. Hym., V., 1898, p. 393.

Brazil: Cayenne.

CHALCIS VICARIA Walker.

Chalcis vicaria Walker, Journ. Ent., I., 1861, p. 183, —.—Dalla Torre, Cat. Hym., V., 1898, p. 393.

Brazil: Ega (Bates).

CHALCIS VILLOSA Olivier.

Chalcis villosa Olivier, Encycl. Méthod. Ins., V., 1790, p. 438.—Dalla Torre, Cat. Hym., V., 1898, p. 393.

St. Trinité.

TRIBE II. *Smicrini.*

Genus SMICRA Spinola.

Under this genus Dr. von Dalla Torre, in his Catalogus Hymenopterorum, has recorded about 200 species, described by Fabricius, Spinola, Walker and others, but of this number scarcely a dozen belong to *Smicra* Spinola, as restricted by Thomson and accepted by Howard and the writer; the vast majority belong to *Spilochalcis* Thomson, but many others fall into other genera characterized in this work.

SMICRA CLAVATA (Fabricius.)

Chalcis clavata Fabricius, Syst. Piez., 1804, p. 162.—Dalla Torre, Cat. Hym., V., 1898, p. 387.

Brazil.

Genus EPITRANUS Walker.

EPITRANUS FULVESCENS Walker.

Epitranus fulvescens Walker, Ent. Mag., II., 1834, p. 26.—Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 55; pl. 3, f. 6 and 7.—Dalla Torre, Cat. Hym., V., 1898, p. 383.

West Indies: St. Vincent; South America: Brazil.

EUSTYPIURA Ashmead, gen. nov.

Allied to *Spilochalcis*, but easily separated by the abdominal differences, the eighth segment being greatly lengthened into a compressed stylus, as in *Stypiura* Kirby.

EUSTYPIURA BICOLOR, sp. nov.

(Plate XXXI., Fig. 4.)

Female.—Length 9.5–10 mm. Pale honey-yellow; eyes green; the pedicel and the first three or four basal joints of the flagellum, the middle and hind coxæ, tips of their tibiæ, middle tarsi, hind trochanters, basal half of hind femora, and the abdomen, except the stylus and sometimes the seventh segment, black, Wings hyaline, tinged with yellowish toward base, the veins light brownish. The hind femora are armed with one moderately large tooth, followed by about fourteen minute teeth.

Male.—Length 7 mm. Agrees well with the female, except that there is a dusky median streak on the mesonotum posteriorly and the abdomen is ovate, without a stylus.

Brazil: Santarem, in April; Chapada, in March and April. Described from five females and two males.

EUSTYPIURA SEXMACULATA, sp. nov.

(Plate XXXI., Fig. 6.)

Female.—Length 9–10 mm. General color pale honey-yellow; pedicel and four or five basal joints of the flagellum, the occiput, a spot on the anterior face of the pronotum, the middle lobe of the mesonotum, except along the parapsidal furrows, the inner margins of the lateral lobes, the axillæ and base of scutellum, the apex of scutellum, tips of hind femora, a spot at apex of hind femora *beneath*, and the base and apex of hind tibiæ, black; the abdomen has some faint transverse brownish bands. Wings hyaline. The hind femora are armed with one moderate-sized tooth at base, followed by sixteen or seventeen minute teeth.

Brazil: Santarem; Maruru; Para. Three specimens. The specimen from Maruru has the basal half of the hind femora black; while that from Para has a spot at base and the apex of the stylus black.

EUSTYPIURA SMITHII, sp. nov.

Female.—Length 12 mm. Pale honey-yellow; the pedicel and the flagellum are brown-black, paler beneath at apex; two triangular black spots on the middle mesothoracic lobe anteriorly, and two faint streaks behind these; the lateral lobes have a black spot on the inner margins; the scutellum has a narrow transverse band at base and its tip black; while the hind femora have a black spot at apex beneath. Wings hyaline, the veins yellowish. The abdomen has the segments two to seven faintly brownish at apex. The hind femora are armed with one large long tooth at base followed by about nine or ten small teeth, the small teeth tipped with black.

Brazil: Santarem. One specimen.

Genus SPILOCHALCIS Thomson.

SPILOCHALCIS ABDOMINALIS (Walker).

Smiera abdominalis Walker, Journ. of Ent., I., 1861, p. 177, ♂.

Smicra ambigua Cresson, Trans. Am. Ent. Soc., IV., 1872, p. 44, ♂.

Smicra abdominalis Cresson, Trans. Am. Ent. Soc., IV., 1872, p. 57, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 372.

Mexico: Orizaba (Sallé); South America: Brazil.

SPILOCHALCIS ACCILA (Walker).

Smiera accila Walker, the Entom., I., 1841, p. 218.—Dalla Torre, Cat. Hym., V., 1898, p. 373.

Brazil (Mr. Shuckard's collection).

SPILOCHALCIS ACUTA (Fabricius).

Chalcis acuta Fabricius, Syst. Piez., 1804, p. 161.—Dalla Torre, Cat. Hym., V., 1898, p. 385.

Brazil.

SPILOCHALCIS ADJUNCTA (Walker).

Smiera adjuncta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 189, ♂.

Smicra adjuncta Dalla Torre, Cat. Hym., V., 1898, p. 373.

Brazil (Mr. Bates).

SPILOCHALCIS ADMIXTA (Walker).

Smiera admixta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 189, ♀.

Smicra adjuncta Dalla Torre, Cat. Hym., V., 1898, p. 373.

Brazil (Mr. Bates).

Genus SPILOCHALCIS Thomson.

Spilochalcis æmula (Walker).

Smiera æmula Walker, Trans. Ent. Soc. London (3), II., 1864, p. 192, ♀.
Smicra æmula Dalla Torre, Cat. Hym., V., 1898, p. 373.
Brazil (Mr. Bates).

Spilochalcis æqualis (Walker).

Smiera æqualis Walker, Trans. Ent. Soc. London (3), II., 1864, p. 200, ♂.
Smicra æqualis Dalla Torre, Cat. Hym., V., 1898, p. 373.
Brazil (Mr. Bates).

Spilochalcis afficta (Walker).

Smiera afficta Walker, Trans. Ent. Soc. London (3), II., p. 184, ♂.
Smicra afficta Dalla Torre, Cat. Hym., V., 1898, p. 373.
Brazil (Mr. Bates).

Spilochalcis alienata (Walker).

Smiera alienata Walker, Trans. Ent. Soc. London (3), II., 1864, p. 195, ♀.
Smicra alienata Dalla Torre, Cat. Hym., V., 1898, p. 393.
Brazil (Mr. Bates).

Spilochalcis annexa (Walker).

Smiera annexa Walker, Trans. Ent. Soc. London (3), II., 1864, p. 204, ♀.
Smicra annexa Dalla Torre, Cat. Hym., V., 1898, p. 373.
Brazil (Mr. Bates).

Spilochalcis annulifera (Walker).

Smiera annulifera Walker, Trans. Ent. Soc. London (3), II., 1864, p. 202, ♀.
Smicra annulifera Dalla Torre, Cat. Hym., V., 1898, p. 373.
Brazil (Mr. Bates).

Spilochalcis apparata (Walker).

Smiera apparata Walker, Trans. Ent. Soc. London (3), II., 1864, p. 186, ♀.
Smicra apparata Dalla Torre, Cat. Hym., V., 1898, p. 373.
Brazil (Mr. Bates).

Spilochalcis appressa (Walker).

Smiera appressa Walker, Trans. Ent. Soc. London (3), II., 1864, p. 186, ♀.
Smicra appressa Walker, Dalla Torre, Cat. Hym., V., 1898, p. 373.
Brazil (Mr. Bates).

Spilochalcis attacta (Walker).

Smiera attacta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 206, ♀.
Smicra attacta Dalla Torre, Cat. Hym., V., 1898, p. 373.
Brazil (Mr. Bates).

SPILOCHALCIS BERGII (Kirby).

Smicra (?) *bergii* Kirby, Ann. & Nat. Hist. (5), XV., 1885, p. 244, ♀ ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 373.

Uruguay.

SPILOCHALCIS BLANDA (Walker).

Smiera blanda Walker, Trans. Ent. Soc. London (3), II., 1864, p. 199, ♀♂.

Smicra blanda Dalla, Torre, Cat. Hym., V., 1898, p. 374.

Brazil (Mr. Bates).

SPILOCHALCIS BURMEISTERI (KIRBY).

Smicra burmeisteri Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 73.—Kirby, Ann. & Mag. Nat. Hist. (5), XV., 1885, p. 243.—Dalla Torre, Cat. Hym., V., 1898, p. 243.

Brazil: St. Paulo; Argentine.

SPILOCHALCIS CAPITULATA (Costa).

Smiera capitulata Costa, Ann. Mus. Zool. Napoli, II. (1862), 1864, p. 68, ♂.

Smicra capitulata Dalla Torre, Cat. Hym., V., 1898, p. 374.

Brazil.

SPILOCHALCIS CELSA (Walker).

Smiera celsa Walker, Trans. Ent. Soc. London (3), II., 1864, p. 201, ♂.

Smicra celsa Dalla Torre, Cat. Hym., V., 1898, p. 374.

Brazil (Mr. Bates).

SPILOCHALCIS COGNATA (Walker).

Smiera cognata Walker, Trans. Ent. Soc. London (3), II., 1864, p. 204, ♀.

Smicra cognata Dalla Torre, Cat. Hym., V., 1898, p. 374.

Brazil (Mr. Bates).

SPILOCHALCIS COMPOSITA (Walker).

Smiera composita Walker, Trans. Ent. Soc. London (3), II., 1864, p. 188, ♀.

Smicra composita Dalla Torre, Cat. Hym., V., 1898, p. 375.

Brazil (Mr. Bates).

SPILOCHALCIS CONGRUA (Walker).

Smiera congrua Walker, Journ. Ent., I., 1861, p. 176, ♀.

Smicra congrua Dalla Torre, Cat. Hym., V., 1898, p. 375.

Brazil: Santarem (Bates).

SPILOCHALCIS CONTRACTA (Walker).

Smiera contracta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 184, ♀.

Smicra contracta Dalla Torre, Cat. Hym., V., 1898, p. 375.

Brazil (Mr. Bates).

SPILOCHALCIS CONTRIBUTA (Walker).

Smiera contributa Walker, Trans. Ent. Soc. London (3), II., 1864, p. 201, ♂.
Smicra contributa Dalla Torre, Cat. Hym., V., 1898, p. 375.
Brazil (Mr. Bates).

SPILOCHALCIS COSTALIS (Walker).

Smiera costalis Walker, Journ. Ent., I., 1861, p. 174, ♀.
Smicra costalis Dalla Torre, Cat. Hym., V., 1898, p. 375.
Brazil: Para.

SPILOCHALCIS DARES (Walker).

Smiera dares Walker, The Entom., I., 1842, p. 338, ♀.
Smicra dares Dalla Torre, Cat. Hym., V., 1898, p. 375.
Brazil (Mr. Shuckard's collection).

(?) SPILOCHALCIS DECIPIENS (Kirby).

Smiera decipiens Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 73.—Dalla Torre, Cat. Hym., V., 1898, p. 375.
Brazil: Villa Nova, Amazon.

SPILOCHALCIS DECISA (Walker).

Smiera decisa Walker, Journ. Ent., I., 1861, p. 176, ♂.
Smicra decisa Dalla Torre, Cat. Hym., V., 1898, p. 375.
Brazil: St. Paulo.

SPILOCHALCIS DEDUCTA (Walker).

Smiera deducta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 206, ♀.
Smicra deducta Dalla Torre, Cat. Hym., V., 1898, p. 375.
Brazil (Mr. Bates).

SPILOCHALCIS DEFUNCTA (Walker).

Smiera defuncta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 189, ♀.
Smicra defuncta Dalla Torre, Cat. Hym., V., 1898, p. 375.
Brazil (Mr. Bates).

SPILOCHALCIS DEMONSTRATA (Walker).

Smiera demonstrata Walker, Journ. Ent., I., 1861, p. 175, ♀.
Smicra demonstrata Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil: Villa Nova (Bates).

SPILOCHALCIS DEMOTA (Walker).

Smiera demota Walker, Trans. Ent. Soc. London (3), II., 1864, p. 205, ♀.
Smicra demota Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil (Mr. Bates).

SPILOCHALCIS DEPICTA (Walker).

Smiera depicta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 203, ♀.
Smicra depicta Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil (Mr. Bates).

SPILOCHALCIS DESCRIPTA (Walker).

Smiera descripta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 197, ♀.
Smicra descripta Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil (Mr. Bates).

SPILOCHALCIS DETRACTA (Walker).

Smiera detracta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 202, ♂.
Smicra detracta Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil (Mr. Bates).

SPILOCHALCIS DIMOTA (Walker).

Smiera dimota Walker, Trans. Ent. Soc. London (3), II., 1864, p. 196, ♀.
Smicra dimota Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil (Mr. Bates).

SPILOCHALCIS DISCALIS (Walker).

Smiera discalis Walker, Journ. Ent., I., 1861, p. 178, ♀.
Smicra discalis Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil : Ega (Mr. Bates).

SPILOCHALCIS DISCOLOR (Walker).

Smiera discolor Walker, Journ. Ent., I., 1861, p. 180, ♀.
Smicra discolor Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil : St. Paulo (Mr. Bates).

SPILOCHALCIS DISPOSITA (Walker).

Smiera disposita Walker, Trans. Ent. Soc. London (3), II., 1864, p. 196, ♀.
Smicra disposita Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil (Mr. Bates).

SPILOCHALCIS ENYO (Walker).

Smiera enyo Walker, The Entom., I., 1841, p. 133, ♀ ♂.
Smicra enyo Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil (Mr. Curtis' collection).

SPILOCHALCIS EXHAURIENS (Walker).

Smiera exhauriens Walker, Trans. Ent. Soc. London (3), II., 1898, p. 198, ♀.
Smicra exhauriens Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil (Mr. Bates).

SPILOCHALCIS EXPLETA (Walker).

Smiera expleta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 197, ♀.
Smicra expleta Dalla Torre, Cat. Hym., V., 1898, p. 376.
Brazil (Mr. Bates).

SPILOCHALCIS FLAVA (Fabricius).

Chalcis flava Fabricius, Syst. Piez., 1804, p. 261.—Dalla Torre, Cat. Hym., V., 1898, p. 388.
South America: Brazil.

SPILOCHALCIS ANDRÉI Ashmead, n. n.

Smicra flavescens André, Ann. Soc. Ent. France (6), I., 1881, p. 343.—Dalla Torre, Cat. Hym., V., 1898, p. 377.
Guiana.

SPILOCHALCIS FOVEATA (Kirby).

Smicra foveata Kirby, Journ. Linn. Soc. Zool., XVII., 1883, p. 71, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 377.
Brazil: Amazon.

SPILOCHALCIS GHILIANII (Spinola).

Smicra ghilianii Spinola, Mem. accad. sc. Torino (2), XIII., 1851, p. 46, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 377.
Brazil.

SPILOCHALCIS GRACILIS (Kirby).

Smicra gracilis Kirby, Ann. & Mag. Nat. Hist. (6), IV., 1889, p. 143.—Dalla Torre, Cat. Hym., V., 1898, p. 377.
Brazil: Theresopolis.

SPILOCHALCIS ILLATA (Walker).

Smiera illata Walker, Trans. Ent. Soc. London (3), I., 1862, p. 348, ♂.
Smicra illata Dalla Torre, Cat. Hym., V., 1898, p. 377.
Brazil: Ega.

SPILOCHALCIS INCERTA (Kirby).

Smiera incerta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 183, ♀ nec ♂.
Smicra incerta Kirby, Journ. Linn. Soc. Zool., XVII., 1883, p. 72.—Dalla Torre, Cat. Hym., V., 1898, p. 377.
Brazil: Amazon.

SPILOCHALCIS LANCEOLATA (Walker).

Smiera lanceolata Walker, Journ. Ent., I., 1861, p. 174, ♀.
Smicra lanceolata Dalla Torre, Cat. Hym., V., 1898, p. 378.
Brazil: Santarem (Mr. Bates).

SPILOCHALCIS LEPREURII (Spinola).

Smicra lepreurii Spinola, Ann. Soc. Ent. France, IX., 1840, p. 98, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 378.

Brazil: Cayenne.

SPILOCHALCIS LOBATA (Costa).

Smiera lobata Costa, Ann. mus. zool. Napoli, II. (1862), 1864, p. 68.
Smicra lobata Dalla Torre, Cat. Hym., V., 1898, p. 378.

? Brazil.

? SPILOCHALCIS LUTEIPENNIS (Walker).

Smiera luteipennis Walker, Journ. Ent., I., 1861, p. 172, ♀ ♂.
Smicra luteipennis Dalla Torre, Cat. Hym., V., 1898, p. 378.

Brazil.

SPILOCHALCIS MULTINOTATA (Costa).

Smiera multinotata Costa, Ann. mus. zool. Napoli, II. (1862), 1864, p. 68, ♀.
Smicra multinotata Dalla Torre, Cat. Hym., V., 1898, p. 379.

? Brazil.

SPILOCHALCIS NEBULOSA (Walker).

Smiera nebulosa Walker, Journ. Ent., I., 1861, p. 180, ♀.
Smicra nebulosa Dalla Torre, Cat. Hym., V., 1898, p. 380.

Brazil: Ega (Mr. Bates).

? SPILOCHALCIS NIGRICORNIS (Fabricius).

Chalcis nigricornis Fabricius, Ent. Syst. Suppl., 1798, p. 243.—Fabricius, Syst. Piez., 1804, p. 163.—Jurine, Nouv. Méth. Class. Hym., 1807, p. 316, ♀ ♂.
Smicra nigricornis Cresson, Trans. Am. Ent. Soc., IV., 1872, p. 57.—Dalla Torre, Cat. Hym., V., 1898, p. 380.

Brazil.

SPILOCHALCIS OBLITERANS (Walker).

Smiera obliterans Walker, Journ. Ent. I., 1861, p. 175, ♀ ♂.
Smicra obliterans Dalla Torre, Cat. Hym., V., 1898, p. 380.

Brazil: Santarem.

SPILOCHALCIS PEIROLERII (Spinola).

Smiera peirolerii Spinola, Ann. Mus. Hist. Nat., XVII., 1811, p. 147 (s. descrip.).
Smicra peirolerii Dalla Torre, Cat. Hym., V., 1898, p. 386.

Brazil.

SPILOCHALCIS PERA (Kirby).

Smicra pera Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 72.—Dalla Torre, Cat. Hym., V., 1898, p. 381.

Brazil.

Spilochalcis picta (André).

Smicra picta André, Ann. Soc. ent. France (6), I., 1881, p. 341, ♀.—Dalla Torre, Cat. Hym , V., 1898, p. 381.

? Brazil.

Spilochalcis pielus (Walker).

Smiera pielus Walker, Ent. Mag., V., 1838, p. 470, ♀.

Smicra pielus Dalla Torre, Cat. Hym., V., 1898, p. 381.

Brazil: Rio de Janeiro.

Spilochalcis pygmæa (Fabricius).

Chalcis pygmæa Fabricius, Syst. Piez., 1804, p. 162.—Blanchard, Hist. Nat. Ins., III., 1840, p. 254.—Dalla Torre, Cat. Hym., V., 1898, p. 392.

Brazil.

Spilochalcis quinquesignata (Costa).

Smiera quinquesignata Costa, Ann. mus. zool. Napoli, II. (1862), 1864, p. 68, ♀.

Smicra quinquesignata Dalla Torre, Cat. Hym., V., 1898, p. 381.

? Brazil.

Siplochacis referator (Walker).

Smiera referator Walker, Trans. Ent. Soc. London (3), I., 1862, p. 347, ♀.

Smicra referator Dalla Torre, Cat. Hym., V., 1898, p. 381.

Brazil: Ega (Mr. Bates).

Spilochalcis sordida (Walker).

Smiera sordida Walker, Journ. Ent., I., 1861, p. 177, ♀.

Smicra sordida Dalla Torre, Cat. Hym., V., 1898, p. 382.

Brazil: Villa Nova (Mr. Bates).

Spilochalcis terminalis (Walker).

Smiera terminalis Walker, Trans. Ent. Soc. London (3), II., 1864, p. 200, ♀.

Smicra terminalis Dalla Torre, Cat. Hym., V., 1898, p. 383.

Brazil (Mr. Bates).

Spilochalcis torrida (Walker).

Smiera torrida Walker, Ann. & Mag. Nat. Hist. (2), X., 1852, p. 46, ♀.

Smicra torrida Dalla Torre, Cat. Hym., V., 1898, p. 383.

Brazil: Para.

Spilochalcis vacillans (Walker).

Smiera vacillans Walker, Trans. Ent. Soc. London (3), II., 1864, p. 199, ♀.

Smicra vacillans Dalla Torre, Cat. Hym., V., 1898, p. 383.

Brazil.

SPILOCHALCIS VARIEGATA (Fabricius).

Chalcis variegata Fabricius, Syst. Piez., 1804, p. 160.—Dalla Torre, Cat. Hym., V., 1898, p. 393.

Brazil (Mr. Bates).

TABLE OF NEW SPECIES.

1. Thorax yellow or mostly yellow.. 15
   Thorax black or mostly black, or *red*.
   Mesonotum entirely black.. 2
   Mesonotum not entirely black.. 5
2. Dorsum of pronotum entirely yellow.. 3
   Dorsum of pronotum not entirely yellow.
   Hind margin of pronotum with a yellow line on each side; clypeus except anteriorly, the front and hind orbits, all tarsi, and a line on each side of the scutellum, yellow; abdomen black with only the petiole yellow, ♀..*S. tarsalis.*
   Hind margin of pronotum entirely yellow; head entirely black; lateral mesothoracic lobes with a yellow spot in front of the tegulæ; scutellum with a yellow line across the base; abdomen entirely black, ♀..*S. atrata.*
3. Middle mesothoracic lobe entirely black.. 4
   Middle mesothoracic lobe not entirely black, either margined with yellow or with minute yellow or reddish dots or spots, sometimes red or red in part.. 5
4. Front orbits, a spot on hind orbits below, the scape, the apical half of scutellum, except the apical ridge, the legs, except a large spot on hind femora *above* at apex and their tarsi, yellow; lateral mesothoracic lobes and the axillæ black; abdomen with the basal half or more ferruginous, ♀....*S. santaremensis.*
5. Thorax above *not* red.. 11
   Thorax above red or red for the greater part.
   Hind coxæ black.. 6
   Hind coxæ ferruginous or yellow, but sometimes with a black spot or line.. 7
6. Head red; thorax except pleura and metathorax which are black, red; scape, front and middle legs and the long petiole of abdomen, yellow; body of abdomen rufous; hind femora and tibiæ ferruginous, ♀..*S. rufodorsalis.*
7. Head normal, seen from in front *not* wider than long.. 8
   Head abnormal, seen from in front much wider than long.
   Thorax, except the sutures, red, the pronotum with a yellowish tinge; scape, front and middle legs, yellow, the middle femora toward apex and the tibiæ toward base brownish, the hind femora dusky at middle; abdomen red, ♀..*S. laticeps.*
8. Thorax *not* mostly red.. 9
   Thorax mostly red.. 10
9. Thorax, except the middle mesothoracic lobe posteriorly and the metathorax which are black, red; base of antennæ and the legs yellow; abdomen yellowish, the petiole black, ♀....*S. nigropetiolata.*
   Thorax, except the middle mesothoracic lobe posteriorly, the lateral lobes and the scutellum which are red, black; head black; front and middle legs yellow; hind femora black; hind tibiæ and tarsi and the long abdominal petiole, yellow, ♀..*S. rufoscutellaris.*
10. Thorax, except the middle mesothoracic lobe posteriorly and the metathorax which are black, red; legs yellow; abdomen pale ferruginous, the petiole black..*S. nigropetiolata.*

Thorax above wholly red, the pleura and metathorax black; head black; scape, front and middle legs and the abdomen at base pale yellowish; hind legs, except tarsi, pale ferruginous, ♀.
S. flavobasalis.

11. Thorax above mostly black, *without* small yellow or reddish dots, the lobes margined with yellow.. 12
Thorax above mostly black, but the dorsum with many small yellow or reddish dots.
Legs mostly black, the knees of front and middle legs, the base and apex of tibiæ, and all tarsi, yellow; abdomen black with two transverse white lines at apex of the second dorsal segment, ♀ .... *S. janeiroensis.*

12. Hind coxæ mostly black *or black with yellow stripes*........ 13
Hind coxæ *not* mostly black; mesothoracic lobes margined with yellow........ 15

13. Hind coxæ *with* a yellow spot at base *above* or striped black and yellow........ 14
Hind coxæ *without* a yellow spot at base. Head, except the front orbits, black; thorax black with a line on each side of the middle mesothoracic lobe and two large spots on the scutellum, yellow; hind femora with a spot at apex, the front and middle legs except the coxæ, the hind tarsi and the petiole of the abdomen, yellow, ♂........ *S. santaremensis.*

14. Vertex with no irregular yellow marks, otherwise similar to *S. flavopetiolata*, except that the scutellum has two oblong yellow spots, one on each side, the metanotum and the mesopleura being immaculate........ 15
Vertex with irregular yellow marks, or the ocelli margined with yellow; front orbits, clypeus, a line on each side of the middle mesothoracic lobe, a spot on the lateral lobes, two oblong spots *at base* of scutellum nearly confluent, two spots on metanotum, a spot on mesopleura beneath the tegulæ and a small spot in front of it, and the legs, except the coxæ, the base of front and middle femora beneath, and most of hind legs which are black, yellow; the hind coxæ have a yellow spot at base above connected with a long yellow stripe beneath; hind femora margined with yellow at base and above, and also with a yellow spot outwardly near the apex; hind tibiæ with a yellow line outwardly extending from near the base to the apex........ *S. flavoorbitalis.*

15. Front wings maculate, or *with* a fuscous spot or cloud from the tip of the stigmal vein........ 16
Front wings immaculate, or *without* a fuscous spot or cloud from the tip of the stigmal vein........ 21

16. Head *not* entirely yellow, the occiput and the scrobes or the middle of the face black........ 17
Head entirely yellow........ 20

17. Scutellum mostly yellow with a central black spot; if black margined with yellow, the axillæ never wholly black, the ridge or plate at apex entire........ 18
Scutellum mostly black with two large yellow spots nearly confluent at apex, the axillæ wholly black, the ridge at apex emarginate; front and middle legs yellow, ♂........ *S. persimilis.*

18. All legs entirely yellow, except a spot, sometimes faint or nearly obsolete, on hind coxæ *above*.... 19
Front and middle legs entirely yellow, the hind legs marked with black, the coxæ more or less black above, ♀........ *S. unimaculata.*

19. Abdomen fusiformly pointed and yellow, except the sheaths of the ovipositor which are black.
All mesothoracic lobes black margined with yellow; scutellum yellow with a large central black spot; mesopleural furrow black; hind coxæ with a distinct black spot, ♀........ *S. perplexa.*
Not all of the mesothoracic lobes black margined with yellow, the lateral lobes being wholly yellow; spot on hind coxæ nearly obsolete, ♀........ *S. imitator.*

20. Thorax mostly yellow with the sutures, a median stripe or line on the middle mesothoracic lobe posteriorly and on the scutellum, black; all legs yellow; abdomen as in *S. imitator*, ♀..... *S. simillima.*
Thorax mostly yellow but with the middle mesothoracic lobe anteriorly and the tip of the metathorax

dusky or black, the scutellum entirely yellow; all legs yellow but the hind coxæ *above* ferruginous or blackish at apex; abdomen ferruginous, the petiole long, blackish at base, the body oblong oval, tinged with fuscous or blackish at sides towards apex, ♂ .... *S. chapadæ.*

21. Thorax *not* entirely yellow 22
Thorax entirely yellow, immaculate 18
22. Middle mesothoracic lobe yellow with two small black spots or short lines on the anterior margin and a black spot posteriorly 78
Middle mesothoracic lobe quite differently marked 23
23. Middle mesothoracic lobe with a large triangular black spot, or black with the sides and the base (the part near the scutellum) margined with yellow or white (the black sometimes with a yellow central spot) 24
Middle mesothoracic lobe with one or more black lines, or with a central black spot 44
24. Middle mesothoracic lobe margined with yellow 25
Middle mesothoracic lobe margined with white.
Head, except the scrobes and the occiput, the pronotum above, the outer margins of the lateral mesothoracic lobes, two large spots on the scutellum, a line on each side of the metathorax and the front and middle legs white or yellowish-white .... *S. albomaculata.*
25. Hind coxæ *not* mostly black, either ferruginous or yellow, but sometimes spotted or striped with black. 26
Hind coxæ nearly wholly black, or at most with a yellowish spot at base above or below; body of abdomen rufous or pale ferruginous, the petiole yellow.
Hind coxæ black except a spot at base *beneath;* mesothoracic lobes mostly red margined with yellow; pleura black, ♀ .... *S. santarema.*
Hind coxæ black except a spot at base *above;* mesothoracic lobes black margined with yellow; abdomen red .... *S. erythrogaster.*
26. Hind coxæ striped longitudinally with black or yellow and black 27
Hind coxæ *not* so marked, at the most with only a black spot, but frequently immaculate, except at the extreme apex 28
27. Lateral mesothoracic lobes along the outer and basal margins yellow; scutellum black with a yellow band across the base, the axillæ wholly yellow, except a delicate black line at base; hind femora mostly yellow with a leg of mutton shaped black spot extending from the base to near the middle, and a curved black line toward apex; abdomen black and yellow, the petiole, base of the second, third and fourth dorsal segments black, ♀ .... *S. flavoaxillaris.*
Lateral mesothoracic lobes with an oblique yellow spot on the outer basal angle; scutellum with two spots at base and its apex yellow, the axillæ wholly black; hind femora mostly black marked with yellow at base and above and with a curved yellow line outwardly at apex; abdomen yellow and black banded, the petiole yellow .... *? S. flavoorbitalis.*
28. All coxæ yellow, immaculate, except sometimes the hind coxæ at the extreme apex 32
All coxæ *not* yellow, immaculate, the hind coxæ maculate or at least dusky at base or at apex or with a large black spot 29
29. Head *not* entirely yellow, the occiput and the scrobes, or the middle of the face, black 30
Head entirely yellow 31
30. Middle mesothoracic lobe margined with yellow and with a small yellow spot in the black before the middle, the lateral lobes margined with yellow outwardly; scutellum margined all around with yellow, the axillæ with a yellow spot behind; dorsum of pronotum yellow with a small black spot on

each side, meso- and metapleura marked with yellow ; hind femora yellow with four black spots on the outer face and one small spot on the inner face ; abdomen short ovate, the petiole about four times as long as thick, the segments 3 to 8 at sides banded with black or fuscous..... *S. marginata.*

31. Face with a long acute tubercle between the insertion of the antennæ, yellow, a large triangular black spot on middle mesothoracic lobe, the outer margins of the lateral lobes, mesopleura, and spot on metanotum black ; abdomen pale ferruginous ; ♀ .... *S. tuberculata.*

32. Middle mesothoracic lobe with a large triangular black spot or black with the sides and the base (the part nearest the scutellum) yellow, the lateral lobes also margined outwardly with yellow...... 33

Middle mesothoracic lobe with one or more black lines, the lateral lobes usually immaculate.... 44

33. Scutellum yellow with a central black line or spot, the axillæ not entirely black, usually yellow with a black spot.. 34

Scutellum yellow with a large quadrate black spot at base, the axillæ black.

Scutellum at apex emarginate or bidentate ; hind femora marked with black ; their tibiæ biannulate with black ; abdomen conic-ovate, the petiole not more than thrice as long as thick. *S. bidentata.*

34. Occiput and the vertex yellow, the scrobes always yellow..................................... 42

Occiput and the vertex black, the scrobes always black.

The triangular black spot on the middle mesothoracic lobe *without* a central yellow spot... 35

The triangular black spot on the middle mesothoracic lobe *with* a central yellow spot...... 39

35. Mesopleural furrow (the femoral furrow of the mesopleura) black 36

Mesopleural furrow *not* black.. 37

36. Hind femora outwardly with a large broad black spot near the base, a small black spot at apex and another above it on the upper margin ; abdomen subglobose, the petiole about four times as long as thick.. *S. maculata*, sp. nov.

Hind femora immaculate, except a black spot within near upper margin ; abdomen oblong oval, faintly tinged with piceous, the petiole three times as long as thick (♂), in female long fusiform or lanceolate, the petiole short, transverse .... *S. hempeli.*

37. Hind coxæ with a black stripe or spot above.. 38

Hind coxæ immaculate.

Hind femora with a large black spot on upper margin within ; scutellum yellow with a median black line.. *S. hempeli.*

Hind femora immaculate ; abdomen fusiformly pointed, some of the dorsal segments banded with fuscous, the petiole four times as long as thick ; ♀ ; scutellum with a large black spot on the disk... *S. devia.*

38. No new species fall in here.

39. Meso- and meta-pleura yellow, except sometimes a black spot in the femoral furrow............. 40

Meso- and meta-pleura, except a spot beneath the insertion of the wings, black.

Hind coxæ black at apex, the hind femora yellow with a large black spot across from the large basal tooth and another smaller spot at apex, the hind femora with a black annulus at base ; body of abdomen short, dusky above ; ♀.............................. *S. nigropleuralis.*

40. Hind femora immaculate... 41

Hind femora with one or two black spots.

Hind femora with two black spots ; abdomen short ovate, shorter than the head and thorax united, the petiole about thrice as long as thick ; ♀ .... *S. bimaculata.*

Hind femora with one black spot ; abdomen oval, the petiole only twice as long as thick ; ♂. *S. corumbicola.*

41. Abdomen in ♀ long, fusiformly pointed, longer than the head and thorax united, the petiole very short, wider than long, in ♂ not longer than the thorax, the petiole thrice as long as thick. *S. mülleri.*

Abdomen in ♀ fusiform, but not longer than the head and thorax united, the petiole nearly thrice as thick, in ♂ oblong-oval. *S howardi.*

42. Front face of pronotum immaculate. 43

Front face of pronotum with a median black spot.

Mesopleura entirely yellow ; ♂. *S. mülleri.*

43. Hind coxæ with a black spot at base *beneath ;* mesopleural furrow and a spot on each side of the metanotum black ; abdomen fusiform, more or less reddish, the dorsal segments banded with black or fuscous, the petiole black and about thrice as long as thick. *S. howardi.*

44. Middle mesothoracic lobe with a small central black spot or with two black spots anteriorly. 80

Middle mesothoracic lobe not so marked.

Middle mesothoracic lobe *with* a central black line its entire length or nearly so. 45

Middle mesothoracic lobe *without* a central black line, but with two lines anteriorly, or these lines are united and form a loop, which is sometimes connected with a short median black line from the base of the scutellum. 64

45. Parapsidal furrows or sutures *not* black. 54

Parapsidal furrows or sutures black.

Hind coxæ immaculate or with only a black spot above, or the extreme apex black, never striped longitudinally with black. 47

Hind coxæ striped longitudinally with black. 46

46. Hind coxæ with a black stripe both above and beneath : metathorax with a central black spot ; abdomen subglobose, banded with black or fuscous above, the petiole a little more than twice longer than thick. *S. insularis.*

Hind coxæ with a black stripe above only ; metathorax dusky medially ; abdomen conically produced, the dorsum banded with black, the petiole not quite twice as long as thick. . . . . *S. trinidadensis.*

47. Hind coxæ immaculate except sometimes at apex. 48

Hind coxæ with a large black spot above.

Hind femora with two black spots, one near the middle and one at the apex ; mesopleural furrow black ; body of abdomen subglobose ; faintly banded, the petiole about thrice as long as thick . . . . *S. incongrva.*

Hind femora immaculate ; a small spot on each lateral mesothoracic lobe ; abdomen elongate lanceolate, much longer than the head and thorax united, the petiole very short, transverse. *S. mayri.*

48. Mesopleura marked with black ; middle mesothoracic lobe with a central black line. 49

Mesopleura immaculate. 53

49. Hind femora maculate. 50

Hind femora immaculate 52

50. The central black line on the middle mesothoracic lobe not or only slightly dilated at the middle. . . 51

The central black line on the middle mesothoracic lobe dilated at the middle ; hind femora with a spot at base beneath and a spot at apex beneath black ; abdomen conic-ovate, the petiole more than thrice longer than thick.

Hind tibiæ *without* a median black band . . . . *S. timida.*

Hind tibiæ *with* a median black band. *S. biannulata.*

51. Hind femora with a black spot at apex beneath but not at base; abdomen conic ovate, the petiole scarcely thrice as long as thick. . . . . *S. media.*
Hind femora with a black spot at base and a black spot at apex; abdomen fusiformly pointed, the petiole about twice as long as thick; ♀. . . . . *S. cameroni.*
52. Abdomen conic-ovate, the petiole about thrice as long as thick; legs immaculate. . . . . *S. enochi.*
53. Abdomen fusiformly produced, longer than the head and thorax united, the petiole very short, wider than long. . . . . *S. fusiformis.*
54. Lateral mesothoracic lobes immaculate. 60
Lateral mesothoracic lobes maculate, or with a black spot or line; front face of pronotum usually with a median black spot, variable in size, sometimes very minute but rarely entirely wanting.
Scutellum *with* a central black line or spot and also with a black line across the base or in the basal suture; sometimes with a large black spot at apex. 55
Scutellum *without* a central black line or spot. 59*
55. Hind coxæ immaculate, except sometimes at apex 56
Hind coxæ with a black spot above toward base.
Hind femora with a black spot at apex . . . . *S. femorata* Fabr.
56. Hind tibiæ *outwardly* entirely yellow. 58
Hind tibiæ *outwardly* more or less fuscous or black, not entirely yellow. 57
57. Hind tibiæ black or fuscous with a broad yellow band before the middle; hind femora with three black spots. . . . . *S. urichi.*
Hind tibiæ black or fuscous at the apical third, yellow basally; hind femora with a black spot at apex beneath; axillæ black; scutellum with a large oval spot towards apex; abdomen conic-ovate, the petiole about five times as long as thick; eyes very large, occupying the whole sides of the head.
S. axillaris.
58. Hind femora *with* a black spot at apex. 59
Hind femora immaculate.
Scutellum *with* a central black line, the apex yellow; middle mesothoracic lobe with a transverse black line anteriorly. . . . . *S. trilineata.*
Scutellum *without* a central black line, the apex with a transverse black spot; middle mesothoracic lobe with two triangular black spots anteriorly. . . . . *S. marshalli.*
59. Middle mesothoracic lobe with a club-shaped central black spot that is connected with a black line across the anterior margin but not extending to the base of the scutellum; lateral mesothoracic lobes with a black line; scutellum with a club-shaped median black spot that is connected with a transverse line at base; a minute spot in mesopleural furrow, the apex of hind coxæ, a spot at apex of hind femora and spots or bands on dorsum of abdomen, black; ♀. . . . . *S. morleyi.*
59*. Some old species fall in here.
60. Middle mesothoracic lobe with a central black line; scutellum with a black line across the base and with the apex black, or with a slight median black line.
Metanotum *without* a central black line. 61
Metanotum *with* a central black line.
Hind femora with a black spot at apex; abdomen fusiformly pointed, the petiole about four times as long as thick; antennæ, except the apical joints, eight to thirteen, yellow.
S. apicalis.
61. Hind femora immaculate. 62
Hind femora maculate, a large black spot at apex and sometimes with a longitudinal black spot; hind

femora armed with a large tooth, followed by eighteen small black teeth; abdomen in ♀ fusiformly pointed, the petiole at least thrice as long as thick, in ♂ long ovate, the petiole at least four times as long as thick .... *S. unilineata.*

62. Hind coxæ immaculate 63
 Hind coxæ with a black stripe *beneath.*
  Mesopleural furrow black; abdomen conic-ovate, more or less banded with fuscous, the petiole *not* thrice as long as thick; legs, except as noted, yellow, immaculate........ *S. lineocoxalis.*
63. Some old species fall in here.
64. The two black lines on the anterior part of the middle mesothoracic lobe unite and form a loop or a delta-shaped mark, which is sometimes connected with the base of the scutellum by a black line. 65
 The two black lines on the anterior part of the middle mesothoracic lobe do not unite to form a loop or delta-shaped mark........ 73
65. Mesopleural spiracles surrounded by black........ 66
 Mesopleural spiracles *not* surrounded by black........ 71
66 The black loop on the middle mesothoracic lobe is connected with the base of the scutellum by a central black line........ 67
 The black loop on the middle mesothoracic lobe is not connected with the base of the scutellum by a central black line........ 71
67. Lateral mesothoracic lobes *not* margined with black along the inner margin, at the most with a black spot........ 68
 Lateral mesothoracic lobes margined with black along the inner margin.
  Hind femora with a black spot on disk outwardly........ *S. chapadensis.*
68. Hind coxæ immaculate, except at extreme apex; abdomen conic-ovate, fusiformly pointed or lanceolate........ 69
 Hind coxæ with a black spot above.
  Abdomen short, globose........ *S. brancensis.*
69. Hind femora immaculate, or at most with a small spot at apex, the disk never maculate........ 70
 Hind femora with a curved black spot across the disk and a small black spot at apex.
  Abdomen conic-ovate .... *S. vagabunda.*
70. Abdomen fusiformly pointed or lanceolate, the petiole at least thrice as long as thick........ *S. magrettii.*
71. Lateral mesothoracic lobes with an abbreviated black line on the inner margin.
  Hind femora immaculate or at most with a small black spot at apex 72
  Hind femora with an oblong black spot on disk near the upper margin.
   Hind coxæ immaculate........ *S. vau.*
72. Hind coxæ with a small black spot above; loop on the middle mesothoracic lobe more or less incomplete, the lines interrupted on each side of the line from the base of the scutellum. ...*S. incompleta*
 Hind coxæ immaculate; loop on the middle mesothoracic lobe complete .... *S. persimilis.*
73. Scutellum with three triangular black spots at base and a triangular black spot at apex. ....*S. fulleri.*
74. Scutellum with three black spots at base, the apex with a black spot or with a central black line.. 75
 Scutellum with a transverse black line at base or with only two black spots........ 76
75. Lateral mesothoracic lobe with a black spot; hind femora with a black spot at apex; abdomen fusiformly pointed, the petiole from two and one half to three times as long as thick.
  Hind coxæ with a black spot at base above; petiole of abdomen yellow; pronotum with four black spots .... *S. hollandi.*
  Hind coxæ immaculate, or without a black spot at base above; petiole of abdomen black; pro-

notum immaculate...S. *corumbæ*.

76. Scutellum with a transverse black line at base, usually in the basal suture........................ 77

Scutellum with *two* black spots at base, connected with a black line in the basal suture; a small black spot at apex.

Lateral mesothoracic lobes with a black spot at apex; abdomen fusiformly pointed, the tip alone black, the petiole only a little longer than thick; ♀....................*S. descripta* Walker.

77. Hind femora with a small black spot at apex; scutellum with a small triangular black spot at apex; abdomen conic-ovate, the petiole about twice as long as thick; ♂..................*S. paraguayensis*.

78. Thorax yellow, a puncture on each side of pronotum, a spot on the lateral mesothoracic lobes, two short lines on the middle lobe anteriorly and a spot posteriorly near the scutellum, a spot on the axillæ and a spot at apex of scutellum, black; legs immaculate; apical half of abdomen black, the petiole nearly *five* times as long as thick; ♂...*S. dimidiata*.

79. Thorax yellow but with the middle mesothoracic lobe with one or more black spots............... 80

Thorax yellow but with the middle mesothoracic lobe immaculate, the lateral lobes with a black spot. 81

80. Middle mesothoracic lobe with two black spots anteriorly; apex of metathorax black; legs yellow, the extreme apex of hind coxæ black, the hind femora with a small black spot at apex...*S. meridionalis*.

Middle mesothoracic lobe with a small central black spot, the lateral lobes with a minute black spot; scutellum with a delicate median black line; abdomen fusiform; segments two to six with fuscous bands; ♂..*S. tripunctata*.

81. Scutellum immaculate; abdomen subglobose; hind femora with two black spots........*S. bipunctata*.

82. Abdomen in ♀ fusiformly pointed, the sheaths of the ovipositor black, the petiole not quite twice as long as thick (in ♂ three or more times longer than thick).....................*S. flava* Fabricius.

SPILOCHALCIS TARSALIS, sp. nov.

Female.—Length 5.5 mm. Black, coarsely punctate; front orbits, face below the insertion of the antennæ, hind orbits, scape beneath, the hind margin of the pronotum, except medially, a line on each side of the scutellum, the base and apex of front tibiæ, all tarsi, and the petiole of the abdomen, yellow. Abdomen subglobose, polished black, except a reddish spot at base beneath.

Brazil: Chapada, in May. One specimen.

SPILOCHALCIS ATRATA, sp. nov.

Female.—Length about 7 mm. (Head lost.) Black, coarsely punctate; hind margin of protonum, a spot on the hind angles of the parapsides, a line across the base of the scutellum and the ridge at apex, and the front knees and tarsi, yellow, the tarsal joints more or less dusky medially.

Brazil: Santarem. One specimen in bad condition.

SPILOCHALCIS SANTAREMENSIS, sp. nov.

Female.—Length 5.5 to 6 mm. Black, coarsely punctate; front and hind orbits, scape, pronotum above, tegulæ, apical half of scutellum, except the ridge at apex,

the apical half or more of front and middle femora and their tibiæ and tarsi, a large spot on upper outer angle of hind femora and the hind tarsi, yellow. Abdomen ovate, the basal half yellowish, the apical half black; the petiole is short, hardly twice as long as thick.

Male.—Length 6 mm. Agrees well with the female, except the middle mesothoracic lobe is margined with yellow, the scutellum has two large yellow spots at the sides, the front and middle legs, except the coxæ, are yellow, while the abdominal petiole *above* is yellow and five or six times as long as thick.

Brazil: Santarem; Chapada, in August. One male and three female specimens.

SPILOCHALCIS RUFODORSALIS, sp. nov.

Female.—Length 8 mm. Mostly red and almost smooth, the mesopleura, the reticulated metathorax and the hind coxæ, except at base beneath and at apex, being black; flagellum brown-black; front and middle legs, tips of hind coxæ, the hind tarsi, and the petiole of the abdomen yellow. The abdomen is ovate, the petiole hardly five times as long as thick.

Brazil: Santarem. One specimen.

SPILOCHALCIS LATICEPS, sp. nov.

Female.—Length 8.5 mm. Mostly red and feebly punctate, the sutures of thorax dusky, the pronotum yellowish; the scape, the front and middle legs, except the thickened part of the front and middle femora and the middle tibiæ basally, and the hind tarsi, are yellow; hind legs reddish, the hind coxæ with a dusky spot above toward base. The abdomen is ovate, the petiole yellow and about thrice as long as thick. The head is abnormal, seen from in front, about twice as wide as long, the face being concave; the eyes are large, rounded and occupy nearly the whole sides of the head, the temples being flat, undeveloped.

Brazil: Santarem. One specimen.

SPILOCHALCIS NIGROPETIOLATA, sp. nov.

Female.—Length 4 mm. Mostly red and faintly rugulosely punctate, the middle mesothoracic lobe posteriorly and the petiole of the abdomen being black; the flagellum, except the first three joints beneath, is brown-black; the front and middle legs are yellowish; the hind legs are pale ferruginous; while the body of the abdomen is pale ferruginous with a black spot on the disk above.

Brazil: Santarem. One specimen.

SPILOCHALCIS RUFOSCUTELLARIS, sp. nov.

Female.—Length 8 mm. Black, faintly punctate, the middle mesothoracic lobe posteriorly, the lateral lobes and the scutellum red; scape, tegulæ, the front and

middle legs and the long abdominal petiole, yellow; hind legs, except the femora, ferruginous, the femora black; body of abdomen black.

Brazil: Chapada, in November. One specimen.

Spilochalcis flavobasalis, sp. nov.

Female.—Length 3 mm. Mostly red; the head, the pleura and the metanotum black; scape, front and middle legs, hind tarsi and basal half of abdomen, including the petiole, pale yellowish; hind legs, except tarsi, pale ferruginous, the femora darker than the coxæ.

Brazil: Chapada. One specimen.

Spilochalcis janeiroensis, sp. nov.

Female.—Length 3.5 mm. Black, punctate; a line on hind orbits, a dot at summit of eyes, a short line on the front orbits, two approximate spots on the middle of the pronotum posteriorly, the lateral margin of same and two dots before, two dots on the middle mesothoracic lobe, three dots of the lateral lobes, and the lateral margins of the scutellum, yellow or yellowish-red; knees, tips of tibiæ and beneath, and all tarsi, yellow; hind legs mostly black, the hind femora with a minute spot above and two irregular spots at apex, yellow; hind tibiæ yellow with a black ring near the middle. The abdomen polished black except two yellowish-white spots on dorsum of the third segment.

Brazil: Rio de Janeiro, in August. One specimen. This species is allied to *S. nigrita* Howard, described from St. Vincent.

Spilochalcis flavoorbitalis, sp. nov.

Female.—Length 7.5 mm. Black, coarsely punctate; irregular marks on vertex, the front and hind orbits, face below antennæ, dorsum of pronotum, except a black spot at sides, the margins of the middle mesothoracic lobe, a spot at the outer basal angle of the lateral lobes, the tegulæ, a spot in front and a spot beneath, two large, oblique, nearly confluent spots at base of scutellum and the ridge at apex, two spots on metathorax, the front and middle legs, except coxæ, more or less of their femora yellow; the hind legs are mostly black, the coxæ striped with yellow beneath and above, the femora margined with yellow at base and above, and with a curved yellow mark outwardly, starting a little beyond the middle and extending to the apex; the hind tibiæ are yellowish outwardly from basal third. The abdomen above is mostly black, banded with yellow, the petiole and the basal half of the second segment being yellow, the following dorsal segments more or less distinctly banded with yellow basally.

Brazil: Santarem. One specimen.

SPILOCHALCIS PERSIMILIS, sp. nov.

Male.—Length 6.5 mm. Black, coarsely punctate; orbits, cheeks, pronotum, except in front, spots on each side, the margins of the middle mesothoracic lobe, a line on the outer margin of the lateral lobes, two large nearly confluent spots towards apex of scutellum, metathorax, except at base above, tegulæ, a spot on mesopleura at insertion of the hind wings, front and middle legs, except coxæ, the petiole of abdomen and the basal half of the second abdominal segment, yellow. The hind legs are broken off and cannot be described. Wings hyaline, with a fuscous spot or cloud enclosing the apex of the stigmal vein; veins dark brown.

Brazil: Chapada. One specimen.

SPILOCHALCIS UNIMACULATA, sp. nov.

Female.—Length 4.5 mm. Black and yellow, punctate. Head yellow, the occiput, a large spot on the forehead and the scrobes black; thorax black, the pronotum above, the margins of the middle mesothoracic lobe, the outer margins of the lateral lobes, the scutellum except a central black spot, the axillæ except a spot at base, the tegulæ, a spot beneath, spots on pleura above, and a transverse spot on each side of the metathorax nearly confluent, yellow; legs yellow, the hind coxæ with a black spot at base beneath and a black or fuscous streak or spot above; the hind femora on outer face are mostly yellow but with a black spot above towards apex, a black streak *beneath* and a black spot beyond it at apex; the inner face is mostly black with a large yellow spot towards apex. Wings hyaline, with a fuscous spot at apex of the stigmal vein.

Brazil: Chapada, in April. Two specimens.

SPILOCHALCIS PERPLEXA, sp. nov.

Female.—Length 5 mm. Head yellow, the occiput, vertex and scrobes black; thorax black marked with yellow, the pronotum yellow, the front face and a small area on each side of dorsum black; middle mesothoracic lobe marginal with yellow, the lateral lobes margined with yellow outwardly at base and along the inner margin at base; scutellum yellow, with a black central spot, the axillæ with a small black spot at base; pleura mostly yellow with two black spots, the metathorax yellow except a black spot at base; legs yellow, the hind coxæ with a black spot above toward base, the femoral teeth small, black, the hind tibiæ with a black line *beneath;* abdomen conically pointed, a little longer than the head and thorax united, the petiole yellow, a little more than thrice as long as thick, the body of abdomen reddish-yellow, the sheaths of the ovipositor black, the first segment with a yellowish spot at each side near base, the second and following segments marked with yellow

at the sides and along the venter. Wings hyaline, with a fuscous spot or cloud from the apex of the stigmal vein; veins brownish.

Brazil: Chapada, in April. One specimen.

SPILOCHALCIS IMITATOR, sp. nov.

Female.—Length 5 mm. Stature and form of *S. perplexa*, but differing in color of thorax, hind legs and abdomen. The parapsidal sutures are black, the middle mesothoracic lobe has a black line down the center, the lateral lobes are reddish, broadly margined with yellow, the scutellum is yellow, with a large central black spot, the hind coxæ have only a faint trace of the black spot above, while the body of the abdomen except the sheaths of the ovipositor, is entirely pale ferruginous, without the yellow marks; otherwise it is scarcely distinguishable from *S. perplexa*.

Brazil: Chapada, in August. One specimen.

SPILOCHALCIS SIMILLIMA, sp. nov.

Female.—Length 5 mm. Stature and form as in the two previous species but differing in color. Yellow, the occiput, the parapsidal furrows, the pronotal suture, a short median line on the middle mesothoracic lobe posteriorly, and the sheaths of the ovipositor, black; the scutellum has a dark line down the center; the hind coxæ, except at the extreme apex, are wholly yellow.

Brazil: Chapada, in April. One specimen.

SPILOCHALCIS CHAPADÆ, sp. nov.

Male.—Length 3.8 mm. Yellow; legs and flagellum brown; middle mesothoracic lobe anteriorly and the tip of the metathorax black or dusky, the hind coxæ above reddish or ferruginous; abdomen ferruginous, the body oblong oval, with some fuscous or blackish stains or marks at sides toward apex, the petiole longer than the metathorax. Wings hyaline, with a fuscous cloud from the apex of the stigmal vein.

Brazil: Chapada, in April. One specimen.

This may be the male of *S. imitator*.

SPILOCHALCIS ALBOMACULATA, sp. nov.

Female.—Length 7 mm. Head black, with the hind and front orbits, the clypeus, the face, the mandibles, except teeth, and the scape, yellowish-white; thorax black, with the dorsum of pronotum, margins of the middle mesothoracic lobe, the outer margins of the lateral lobes, two large spots on scutellum, nearly confluent at apex, and the depression on each side of the metathorax, yellowish-white; petiole of abdomen and front and middle legs, yellowish-white; body of

abdomen conic-ovate, the basal half pale ferruginous, the apical half black; hind legs mostly black, the hind coxæ reddish at base above, the hind femora with three large whitish spots, the tibiæ black or brown-black, the tarsi white.

Brazil: Corumba, in May. One specimen.

SPILOCHALCIS SANTAREMA, sp. nov.

Female.—Length 4 mm. Head mostly yellow, the occiput black, the vertex brownish at the middle; flagellum black; thorax black beneath and at apex, the pronotum yellow, the mesonotum reddish or reddish-brown, the lobes margined with yellow, the middle lobe blackish down the center, the scutellum black margined with yellow; body of abdomen ovate, ferruginous, the petiole yellow and about thrice as long as thick, the sheaths of the ovipositor black; the front and middle legs are entirely yellow, the hind legs are mostly black, their femora with a large yellow spot at the upper outer angle and a small spot beneath it, their tibiæ narrowly black or dark fuscous at base and at apical third, while the tarsi are yellow. Wings hyaline, the veins brown-black.

Brazil: Santarem. One specimen.

SPILOCHALCIS ERYTHROGASTER, sp. nov.

Female.—Length 5.5 mm. Black, coarsely punctate; orbits, face below insertion of antennæ, the dorsum of pronotum, the margins of the middle mesothoracic lobe, the lateral lobes outwardly, the tegulæ, two large spots on the scutellum, a spot enclosing the metathoracic spiracles, the short abdominal petiole, and the front and middle legs, yellow; the hind legs are mostly black, the tarsi, a spot at base of coxæ above and three spots on hind femora, yellow; body of abdomen ovate, rufous, the sheaths of the ovipositor black. Wings hyaline, the veins brown-black.

Brazil: Chapada and Santarem. Two specimens.

SPILOCHALCIS FLAVOAXILLARIS, sp. nov.

Female.—Length 7.5 mm. Black, coarsely punctate; orbits a Λ-shaped mark on the face below the insertion of the antennæ, the clypeus, the dorsum of the pronotum, except a line at the sides, the margins of the middle mesothoracic lobe, the outer margins of the lateral lobes, a line across the base of the scutellum and the axillæ, yellow; the abdomen, except the petiole, the base of the second segment, a band at the base of the third and fourth segments which are black, is mostly yellow; the front and middle legs are yellowish and ferruginous marked with black, the hind legs black and yellow; the hind coxæ are black with a small yellow spot at apex and a yellow stripe above, the hind femora are yellow with a black line at

base, the outer face with a triangular black spot on basal half and a curved black line at apex; the inner face has two large black bands or stripes. Wings hyaline, with a yellowish tinge, the veins pale ferruginous.

Brazil: Santarem. One specimen.

Spilochalcis marginata, sp. nov.

Female.—Length 5 mm. Head, except the occiput and the scrobes which are black, yellow; flagellum black; dorsum of pronotum, except a small black spot on each side, the margins of the middle mesothoracic lobe and a small spot anteriorly, the outer margins of the lateral lobes, the scutellum except a large central black spot, the metathorax except a central black stripe, the tegulæ, a spot beneath, and the margins of the metapleura, yellow; legs mostly yellowish-white, the hind coxæ with a large black spot above, the hind femora with three black spots on outer face, a small spot above towards apex and a single spot on the inner face, black. Abdomen yellow, the dorsal segments banded with black.

Brazil: Santarem. One specimen.

Spilochalcis tuberculata, sp. nov.

Female.—Length 4 mm. Yellow; eyes and flagellum brown; lobes of mesothorax black margined with yellow; a spot on scutellum at base, a spot on metanotum and the pleura black. The abdomen is conic-ovate, ferruginous, the petiole yellow and about thrice as long as thick. The hind femora are armed with nineteen or twenty minute teeth beneath and have a black or brownish spot at apex. The face is armed with a very long tubercle, which originates from the ridge between the insertion of the antennæ.

Brazil: Chapada, in January. One specimen.

Spilochalcis bidentata, sp. nov.

Female.—Length 6.5 mm. Black, coarsely punctate; orbits, the face below the insertion of the antennæ, the scape beneath, the apex of flagellum, the prothorax, except a spot on each side of the front face of the pronotum, the margins of the middle mesothoracic lobe at sides and base and the outer and basal margins of the lateral lobes, a band all around the scutellum, the metathorax, and the upper part of the mesopleura, yellow; legs mostly yellow, the hind legs marked with black, the hind tibiæ with a black annulus at base and another one near the middle. The abdomen is yellowish or pale ferruginous, the dorsal segments, three and beyond, more or less blackish or fuscous.

Brazil: Santarem. One specimen.

SPILOCHALCIS MACULATA, sp. nov.

Female.—Length 6.5 mm. Black, coarsely punctate; orbits, a line connecting the ocelli, face below antennæ, cheeks, the scape, the dorsum of pronotum, except a triangular black spot at basal lateral angles, the margins of the middle mesothoracic lobe, the outer margins of the lateral lobes, the scutellum except a central black line, the metathorax except a transverse line at base, the tegulæ, a spot beneath, the anterior margin of the mesopleura, a large spot on the side of the metapleura and the legs, except the hind femora, yellow; the hind femora have a large black spot toward base, a black spot at apex beneath, and a black spot above toward apex. The abdomen is short ovate, banded with black, the petiole about four times as long as thick.

Brazil: Chapada, in December. One specimen.

SPILOCHALCIS HEMPELI sp. nov.

Female.—Length 8.5 mm. Head, except the occiput and the scrobes, which are black, yellow; scape and apex of the flagellum yellow, the first five joints of the funicle black; prothorax, except the front face, the margins of the middle mesothoracic lobe, the lateral margins of the lateral lobes, the scutellum except a large oblong, central black spot, the metathorax, except a narrow, central black line, the sides of the thorax and the legs, except the minute black teeth on the hind femora and a black stripe on the hind tibiæ *beneath,* yellow. The abdomen is conically produced, longer than the head and thorax united, the eighth segment being styliform, the petiole very short transverse; it is yellowish with dorsal segments three to six more or less dusky or fuscous basally and appearing banded, when viewed from above.

Male.—Length 5.4 mm. Differs from the female in the shape of the abdomen which is long oval, the petiole being about four times as long as thick, the dorsal segments not banded, while the hind femora have a large black spot on inner face near the upper margin.

Brazil: Santarem.

Named in honor of Mr. Adolph Hempel.

SPILOCHALCIS DEVIA, sp. nov.

Female.—Length 6 mm. Yellow; a spot on vertex extending on to the occiput, and a line in the antennal depression, black; flagellum brown at base but becoming fulvous from the third joint; thorax mostly yellow but marked with black as follows: The prothorax is yellow with a small black spot on each side *above* and a large transverse black band on the front face or the declivity; the middle meso-

thoracic lobe is black broadly margined with yellow, the lateral lobes black marked with yellow along the outer sides; the scutellum is yellow with a large, triangular, central black spot, and a transverse black line at base, dilated on the axillæ; the metathorax has a transverse black line at base. The abdomen is fusiform, pale ferruginous, except the petiole, the dorsum with four or five brownish bands, the sheaths of the ovipositor black; the petiole is yellow and about five times as long as thick. The hind femora are armed with thirteen or fourteen black teeth, while the hind tibiæ have a black spot on the outer face near the middle.

Brazil: Santarem. One specimen.

SPILOCHALCIS NIGROPLEURALIS, sp. nov.

Female.—Length 4.3 mm. Lemon-yellow, marked with black as follows: The occiput and a small spot in front of the lateral ocelli black; flagellum black; pronotum with a small spot on each side and a large median spot on the declivity or front face, black; mesothorax black, the lobes margined with yellow, the middle lobe also with a small yellow spot anteriorly; scutellum yellow, with a transverse line across the base, dilated on the axillæ, and a wedge-shaped central spot, black; basal suture of metathorax, the pleuræ, except spots beneath the insertion of the wings, black; the body of the abdomen is short, subovate, the dorsal segments two to seven medially more or less black; all the legs are yellow but marked with black as follows: The hind coxæ at apex, the trochanters, two large spots on the outer and inner face of hind femora and the base of the hind tibiæ, are black.

Male.—Length 4 mm. Colored and marked nearly as in the female, except the yellow spot on the middle mesothoracic lobe is greatly enlarged and divides the black into two parts, while the pleuræ, except the femoral furrow, are yellow.

West Indies: Trinidad; Brazil: Chapada.

SPILOCHALCIS CORUMBICOLA, sp. nov.

Male.—Length 6 mm. Lemon-yellow; occiput, scrobes and the scape *above*, black; flagellum brown-black, fulvous beneath; pronotum with a median spot on the front face and a small spot on the dorsum opposite the parapsidal furrows, black; mesothoracic lobes black margined with yellow, the middle lobe also with a yellow median spot; scutellum with a transverse black line at base and a narrow black line down the center; hind femora with a small rounded spot on outer and inner face and the minute teeth, about fourteen, black. The body of the abdomen is oval, mostly ferruginous, the dorsal segments tinged with fuscous basally, while the petiole is yellow and about twice as long as thick.

Brazil: Corumba, in April. One specimen.

SPILOCHALCIS MÜLLERI, sp. nov.

Female.—Length 0 mm. Yellow, the occiput black, the black extending forward on the vertex and enclosing the ocelli; flagellum brown-black basally, the four or five apical joints fulvous; mesothoracic lobes black broadly margined with yellow, the black on the middle lobe with usually a central yellow spot; scutellum with a central black line and a black line across the base. The abdomen is elongate lanceolate or fusiformly pointed, longer than the head and thorax united, the eighth segment long, styliform, the petiole very short, transverse.

Brazil: Santarem. Three specimens.

Dedicated to the memory of Dr. Fritz Müller.

SPILOCHALCIS HOWARDI, sp. nov.

Female.—Length 7 mm. Yellow; the occiput, scrobes, a broad median line extending from the insertion of the antennæ forwards to the mandibles, the 3-dentate mandibles, the antennæ, a median band on the middle mesothoracic lobe widened anteriorly, a large spot on the lateral lobes, a central line on the scutellum, the femoral furrow on the mesopleura and anteriorly, the lower part of metapleura, the depression on each side of the metanotum, spots on front and middle coxæ, a large spot on the hind coxæ at base beneath, their apices, the abdominal petiole and bands on the dorsal abdominal segments, black. The body of the abdomen is fusiformly pointed, blackish at apex, the about three times as long as thick. The hind femora are armed with about twenty small teeth.

Brazil: Chapada, in November. One specimen.

Named in honor of Dr. L. O. Howard.

SPILOCHALCIS INSULARIS, sp. nov.

Male.—Length 5 mm. Yellow; a spot on occiput, a median spot on the front face of the pronotum, the sutures of the mesothoracic lobes, a line down the center of the middle lobe, a spot on the lateral lobes, a central line on the scutellum, a median line on the metanotum, the front margin of the mesopleura, a stripe on hind coxæ *beneath* and *above*, and three or four bands on the dorsal abdominal segments, black. The hind femora are armed with about twenty minute, black teeth.

West Indies: Trinidad.

SPILOCHALCIS TRINIDADENSIS, sp. nov.

Female.—Length 9 mm. Yellow; a spot on the occiput, the scrobes, the antennæ, except the scape beneath, a median line on front face of the pronotum, the sutures of the mesothoracic lobes, a central line on the middle lobe, a large spot on

the lateral lobes, a central line on the scutellum, a median line on the metathorax, a spot on the mesosternum anteriorly, the femoral furrow on the mesopleura, a stripe on the hind coxæ *above*, and six bands on dorsum of abdomen, black. The abdomen is fusiformly pointed, a little longer than the head and thorax united, the petiole short, not longer than thick. The hind femora are armed with from twenty to twenty-two minute teeth.

West Indies: Trinidad. One specimen.

SPILOCHALCIS INCONGRUA, sp. nov.

Male.—Length 6 mm. Yellow, with black markings very nearly as in *S. trinidadensis* but with the following differences: The metathorax is *without* the median black line, the antennæ are wholly yellow, except the flagellum *above*, the hind coxæ have a small black spot *above*, while their extreme apices, including the first joint of the trochanters, are black; the hind femora have two black spots on outer face, one near the middle, the other at the apex and are armed with sixteen to seventeen small, black teeth; the hind tibiæ are entirely yellow.

Brazil: Chapada, in April. One specimen.

SPILOCHALCIS MAYRI, sp. nov.

Female.—Length 5.5 mm. Yellow; occiput with a transverse black spot; flagellum brown-black; a small median spot on front face of pronotum, the parapsidal furrows, a transverse line on the anterior margin of the middle mesothoracic lobe and a longitudinal line down the center, a small spot on each lateral lobe, a median line on the scutellum, a line in the mesopleural furrow and a spot on the hind coxæ *above* black.

The abdomen is long, lanceolate, about twice as long as the head and thorax united, the petiole very short transverse, the dorsal segments more or less banded with fuscous, the terminal segment styliform. The hind femora are armed with one large tooth, followed by fourteen or fifteen minute teeth.

Brazil: Chapada, in May. One specimen.

SPILOCHALCIS TIMIDA, sp. nov.

Female.—Length 4 mm. Yellow, with the black markings much as in *S. incongrua* but with the following differences: The flagellum is wholly black, the hind coxæ have the apices alone black, the hind femora have two black spots and are armed with about seventeen small black teeth, while the hind tibiæ are black at base.

Brazil: Corumba, in April.

SPILOCHALCIS BIANNULATA, sp. nov.

Female.—Length 5.5 mm. Yellow, with the black markings much as in *S. timida*, but differing as follows: The black lines on the middle mesothoracic lobe form an anchor-shaped mark ⊥, the scutellum has an acute wedge-shaped black spot at apex, the hind femora have a large, irregular, black spot at basal third and a small black spot at apex below, while the hind tibiæ have two black rings, one at base, the other near the middle. The abdominal petiole is rather slender and four or more times longer than thick, the body of abdomen being ovate, black at apex and with some fuscous stains on the dorsal segments.

Brazil: Santarem. One specimen.

SPILOCHALCIS MEDIUS, sp. nov.

Female.—Length 4 mm. Yellow, with black markings much as *S. timida*, but differing as follows: The black central line on the middle mesothoracic lobe is only slightly dilated, the spots on the lateral lobes are smaller, nearly round and do not touch the parapsidal furrow as in *S. timida*, the hind femora have only a small black spot at apex and are armed with seventeen or eighteen minute black teeth, while the body of the abdomen is conic-ovate, black at tip, the petiole not slender, about thrice as long as thick.

Brazil: Corumba, in March. One specimen.

SPILOCHALCIS CAMERONI, sp. nov.

Female.—Length 4.5 mm. Yellow, with the black markings much as in *S. medius*, only the middle mesothoracic lobe has besides the median black line two other lines anteriorly, between the parapsidal furrows and the median line, that extend to the middle of the lobe; the hind femora have a black spot at base and a black spot at apex and are armed with about sixteen small black teeth; while the abdomen is conically pointed, blackish at apex, the dorsal segments stained with fuscous near the sutures, the petiole being about twice as long as thick.

Brazil: Rio de Janeiro. One specimen.

SPILOCHALCIS ENOCKI, sp. nov.

Female.—Length 5.75 mm. Yellow, with black markings as follows: The sutures of the mesonotum, a central line on the middle mesothoracic lobe, an oblong spot on the lateral lobes, a central line on the scutellum, a stripe on front margin of the mesosternum and a spot or line in the mesopleural furrow, are black; legs immaculate, the hind femora armed with about seventeen minute teeth, the teeth tipped with black; abdomen fusiformly pointed, the sheaths of the ovipositor black,

the dorsal segments more or less stained with fuscous, the petiole being about twice as long as thick.

West Indies: Trinidad.

Named in honor of Mr. Frederick Enock.

Spilochalcis fusiformis, sp. nov.

Female.—Length 6.5 mm. Yellow, with black markings as follows: The parapsidal furrows, the suture at base of the scutellum, a median line on the scutellum, a central line on the middle mesothoracic lobe and two additional short lines anteriorly, one on each side of the central line, that extend to nearly half the length of the lobe, and a spot at base of the metanotum, black; flagellum brown-black above. The abdomen is elongate, fusiform, or lanceolate, as seen from the side, and longer than the head and the thorax united; the sheaths of the ovipositor alone being black; the petiole is very short, wider than long. The legs are immaculate, the hind femora being armed with about seventeen small black or black-tipped teeth.

Brazil: Porto Branca. One specimen.

Spilochalcis urichi, sp. nov.

Male.—Length 4 mm. Yellow marked with black as follows: The occiput, a central line on the middle mesothoracic lobe that is connected with a transverse line along the front margin, a large oblong spot on the lateral lobes, a line across the base of the scutellum and a wedge-shaped spot at apex, a spot in the mesopleural furrow, apex of hind coxæ, the base of hind femora, an oblong spot on disk of outer face and a spot at apex, and the hind tibiæ, except a broad yellow annulus, black.

The hind femora are armed with about twenty-five minute black teeth.

West Indies: Trinidad.

Named in honor of Mr. F. W. Urich.

Spilochalcis axillaris, sp. nov.

Female.—Length 4 mm. Yellow marked with black as follows: The occiput, a spot on front face of pronotum, a broad central black line on the middle mesothoracic lobe, not quite extending to the anterior margin, a small spot on each side of this line anteriorly, a large oblong spot on the lateral lobes, a large spot at apex of the scutellum, the sutures at base and the axillæ, a spot at base of metathorax, a line in the mesopleural furrow, the apex of the hind coxæ, a spot at apex of hind femora, the apical third of hind tibiæ and some spots on the dorsum of abdomen, black.

The flagellum is black or brown-black, the scape and pedicel being yellow. The abdomen is conic-ovate, the petiole being about five times as long as thick. The hind femora are armed with seventeen small teeth.

Brazil: Santarem. One specimen.

SPILOCHALCIS TRILINEATA, sp. nov.

Female.—Length 5.5 mm. Yellow; a short line on the middle of the occiput, a large spot on the front face of the pronotum, a central line on the middle mesothoracic lobe connected with a transverse line anteriorly, an abbreviated line on the inner margins of the lateral lobes, a median line on the scutellum, and a line across the base, black. The hind femora are armed with seventeen or eighteen minute teeth. The abdomen is conic-ovate, the petiole being more than five times as long as thick.

Brazil: Santarem.

SPILOCHALCIS MARSHALLI, sp. nov.

Female.—Length 6.5–7 mm. Yellow; a line on scape above, the flagellum, a transverse spot at apex of the scutellum and a transverse line across the base, an abbreviated line along the inner margin of the lateral lobes of the mesonotum, a median line the entire length of the middle lobe, and two triangular spots on the anterior margin (one on each side of the median line), black. The abdomen is fusiform, the middle dorsal segments more or less blackish, or stained with fuscous, the base and apex, except the sheaths of the ovipositor, always yellow, the petiole being about twice as long as thick. The legs are immaculate, the hind femora armed with one large tooth, followed by about fifteen minute black teeth.

Male.—Length, 4–4.5 mm. Agrees in color with the female, but the body of the abdomen is long ovate, the petiole being a little more than three times as long as thick, while the basal tooth of the hind femora is followed by eighteen or nineteen minute black teeth.

West Indies: Trinidad. One female and three male specimens.

Named in honor of Rev. T. A. Marshall.

SPILOCHALCIS MORLEYI, sp. nov.

Female.—Length 5.5 mm. Yellow; a line on scape above towards the apex, the flagellum, a clavate, central spot on the scutellum connected with a transverse line at base, a line along the inner margins of the lateral mesothoracic lobes, a clavate median line on the middle lobe that is connected with a transverse line anteriorly, a small spot in the mesopleural furrow, the apex of hind coxæ, a spot at apex of hind femora, and two or three bands on the dorsum of the abdomen, black. The abdomen is short ovate, or subglobose, the petiole being a little more than three

times as long as thick. The hind femora are armed with seventeen or eighteen minute teeth.

Brazil: Bahia. Taken by Mr. Albert Koebele, March 19, 1883. Named in honor of Mr. Claude Morley.

Spilochalcis apicalis, sp. nov.

Female.—Length 4 mm. Yellow; the apical half of the flagellum, a spot on the occiput, a spot on front face of the pronotum, a transverse spot at apex and a transverse line at base of scutellum, a median line the entire length of the middle mesothoracic lobe, a central black spot on the metathorax, the extreme tips of hind coxæ; and a spot at apex of hind femora, black. The abdomen is conic-ovate, the sheaths of ovipositor black, the petiole being at least three times as long as thick. The hind femora are armed with one large acute tooth, followed by twelve minute black teeth.

Brazil: Rio de Janeiro. One specimen.

Spilochalcis unilineata, sp. nov.

Female.—Length 6.5 to 7 mm. Yellow; the flagellum, a small spot on the occiput, a dot on front face of pronotum, a central line on the middle mesothoracic lobe, a transverse line at base of scutellum and a transverse spot at apex, and a spot at apex of hind femora, black. The abdomen is fusiformly pointed, longer than the head and thorax united, the apex and the sheaths of the ovipositor black, the petiole being more than three times as long as thick. The hind femora are armed with one large tooth, followed by about eighteen minute black teeth.

West Indies: Trinidad.

Spilochalcis lineocoxalis, sp. nov.

Female.—Length 4 mm. Yellow; the occiput in part, a line along the malar suture, teeth of mandibles, the flagellum above, a short line on the front face of the pronotum, a small spot at the apex of the scutellum, a longitudinal median line anteriorly and a transverse line at base, a median longitudinal line on the middle mesothoracic lobe and a line across the anterior margin, a line between the pro- and mesosternum, the mesopleural furrow, the metasternum, a stripe on hind coxæ *beneath* and bands on the dorsum of the abdomen, black. The abdomen is fusiform, the petiole about, or nearly, three times as long as thick. The hind femora are armed with a moderately large tooth followed by about twelve minute black teeth.

Brazil: Corumba, in May. One specimen.

Spilochalcis fulleri, sp. nov.

Female.—Length 7 mm. Yellow; a transverse spot on occiput, the flagellum, a triangular spot at apex of scutellum and three triangular spots at base, an oblong

spot on the lateral lobes of the mesothorax, two lines on the middle lobe anteriorly for about two thirds its length, a spot at apex of hind coxæ *above*, a spot at apex of hind femora and the sheaths of the ovipositor, black. The abdomen is fusiform, longer than the head and thorax united, the petiole being only twice as long as thick. The hind femora are armed with one large tooth, followed by about sixteen minute black teeth.

West Indies: Trinidad. One specimen.

Named in honor of Mr. Claude Fuller.

SPILOCHALCIS CORUMBENSIS, sp. nov.

Female.—Length 9 mm. Yellow; the occiput, the flagellum, a minute dot towards apex of the scutellum, the suture across its base, a spot on the lateral lobes of the mesothorax, a loop on the middle lobe anteriorly, a small spot in the mesopleural furrow, and the extreme apex of hind coxæ, black.

The abdomen is fusiformly pointed, longer than the head and thorax united, the petiole very short, transverse. The hind femora are armed with fourteen or fifteen minute teeth.

Brazil: Corumba, in April. One specimen.

SPILOCHALCIS CHAPADÆ, sp. nov.

Female.—Length 4.3 mm. Yellow; the occiput, scrobes, flagellum, a median longitudinal line on scutellum and the suture at base, a broad line along the inner margins of the lateral mesothoracic lobes, a loop connected with a short median line from the base of the scutellum, on the middle lobe, the mesopleural furrow, the apex of the hind coxæ, a small oblong spot on disk of the outer face of the hind femora and a spot at apex, and most of the body of the abdomen, black.

The abdomen is conic-ovate, the petiole at least thrice as long as thick. The hind femora are armed with fourteen or fifteen minute black teeth.

Brazil: Chapada, in April. One specimen.

SPILOCHALCIS BRANCENSIS, sp. nov.

Female.—Length 6 mm. Colored and marked very nearly as in *S. chapadæ*, except that the black spots on the lateral lobes of the mesothorax are shorter, the scutellum has a wedge-shaped black spot at the middle, the hind coxæ have a rounded spot *above*, while the hind femora have two black spots.

Structurally, however, there is no resemblance: The head in front is deeply semicircularly emarginate for the reception of the antennæ; the antennæ are separated at base by a sharp carina or spine; the hind coxæ are not nearly so long; the

hind femora are armed with sixteen or seventeen small black teeth; while the abdomen is subglobose, the dorsal segments stained with black or piceous, the petiole about three times as long as thick.

Brazil: Porto Branca. One specimen.

Spilochalcis vagabunda, sp. nov.

Female.—Length 7.5 mm. Yellow, the head and thorax marked with black as in *S. brancensis* but structurally it is quite different: The head is broader, not deeply semicircularly emarginate in front; the abdomen is conically pointed, longer than the head and thorax united, the sheaths of the ovipositor black, the petiole short, not longer than thick; some of the dorsal segments are more or less banded with brown or black; the hind coxæ have a black spot at apex, their femora have a black line at base and along the lower or serrate edge, the same being connected with an arcuate black mark on the outer face and a spot at apex. The hind femora are armed with about eighteen minute black teeth.

Brazil: Santarem.

Spilochalcis lanceolata, sp. nov.

Female.—Length 5.5 mm. Colored and marked with black much as in *S. vagabunda*, except that the pleura are immaculate, the hind femora have a black spot only at apex and are armed with only fourteen minute black teeth. It also differs decidedly in the shape of the abdomen, which is long, lanceolate, the petiole being much longer, at least three times as long as thick.

Brazil: Santarem.

Spilochalcis vau, sp. nov.

Female.—Length 5 mm. Yellow; a spot on the occiput, a V-shaped mark on the middle mesothoracic lobe anteriorly, not connected with a black line posteriorly, a spot on each lateral lobe, a line across the base of the scutellum and an abbreviated longitudinal line on the disk, a line in the mesopleural furrow, an oblong mark on the outer face of the hind femora, the abdominal petiole, and bands on dorsal segments of the abdomen, black; scape and pedicel wholly yellow (flagellum broken off). The abdomen is ovate, the petiole being long, about six times as long as thick. The hind femora are armed with about fifteen minute black teeth.

Brazil: Chapada, in April. One specimen.

Spilochalcis incompleta, sp. nov.

Female.—Length 6.0 mm. Yellow: marked with black as in *S. vau*, only the loop on the middle mesothoracic lobe is open posteriorly and there is a black line extending from it to the base of the scutellum, the scape has a black line *above*, the

flagellum being wholly black, the hind coxæ have a small black spot near the middle *above*, the hind femora have a minute spot on the middle of the disk and a black spot at base and apex.

The abdomen is conically pointed, longer than the head and thorax united, the sheaths of the ovipositor and a slender band at base of dorsal segments 3 to 7, black; the petiole is hardly longer than thick. The hind femora are armed with one moderate sized tooth, followed by about eighteen minute black teeth.

Brazil: Corumba, in May. One specimen.

SPILOCHALCIS PERSIMILIS, sp. nov.

Female.—Length 4 mm. Yellow; the thorax marked with black as in previous species, except that the loop is complete, not interrupted before uniting with the median black line posteriorly; the hind coxæ and femora are immaculate.

The abdomen is conic-ovate, not so long nor so pointed as in previous species, the dorsal segments four to seven brownish or blackish, the petiole being three times as long as thick. The hind femora are armed with about fifteen minute black teeth.

Brazil: Corumba, in April. One specimen.

SPILOCHALCIS HOLLANDI, sp. nov.

Female.—Length 0.5 mm. Yellow; the occiput, a line on the scrobes enclosing the front ocellus, a line on the scape *above*, the flagellum, two median lines on the front face of the pronotum and a line on each side of the dorsum, two broad lines on the middle mesothoracic lobe anteriorly, a spot on the lateral lobes, three triangular spots at base of scutellum, the middle one being connected with a central line that extends to and terminates in a spot at the apex of the scutellum, a large rounded spot at base of hind coxæ *above*, the apex of hind coxæ, a spot at apex of hind femora, the extreme base of hind tibiæ and an annulus at the middle, all black.

The abdomen is conically produced, longer than the head and thorax united, the petiole only about twice as long as thick. The hind femora are armed with one large tooth, followed by about eighteen minute teeth.

Brazil: Santarem. One specimen.

Named in honor of Dr. W. J. Holland.

SPILOCHALCIS CORUMBÆ, sp. nov.

Female.—Length 7.5 to 8 mm. Yellow, marked with black as in *S. hollandi* except that the spots at base and apex of scutellum are not connected by a central black line, the hind coxæ being *without* the spot at base above, while the apical seg-

ment of the abdomen is wholly black, the petiole being hardly longer than thick. The hind femora are armed with one large tooth followed by fifteen or sixteen minute black teeth.

Brazil: Corumba; Porto Branca; West Indies: Trinidad.

Spilochalcis paraguayensis, sp. nov.

Male.—Length 6 mm. Yellow, marked with black as in *S. corumbæ*, except that the scutellum has a slender black line across the base and a triangular spot at apex; the hind coxæ have the apex black; the hind femora have black spot at apex as in *S. corumbæ*, but a large tooth is followed by seventeen or eighteen minute black teeth. The abdomen is fusiform, the petiole being three times as long as thick.

Paraguay: Villeta. One specimen.

Spilochalcis dimidiata, sp. nov.

Male.—Length 4.5 mm. Yellow; a spot on occiput, the ocelli, a small spot on each side of the dorsum of the pronotum, a quadrate spot at the base of the middle mesothoracic lobe, just in front of the scutellum, and two short longitudinal lines anteriorly, a spot on the lateral lobes, a triangular spot at apex of the scutellum, and the apical half of the abdomen, black. The body of the abdomen is ovate, the petiole being long, a little more than four times longer than thick. The hind femora are armed with sixteen or seventeen minute, black teeth.

Brazil: Chapada, in October. One specimen.

Spilochalcis meridionalis, sp. nov.

Female.—Length 4 mm. Yellow; the occiput, the flagellum, two triangular spots on the anterior margin of the middle mesothoracic lobe, a faint dot on the lateral lobes, the axillæ and a spot at base of scutellum, a median line on the metanotum and its apex, the extreme apex of hind coxæ, a spot at apex of hind femora, and the sheaths of the ovipositor, black.

The abdomen is conic-ovate, the petiole being a little more than three times as long as thick; the dorsal segments are more or less stained with brown or fuscous.

The hind femora are armed with one large acute tooth, followed by thirteen or fourteen smaller teeth, those near the apex being very minute.

West Indies: Trinidad. One specimen.

Spilochalcis tripunctata, sp. nov.

Male.—Length 3.5 mm. Yellow; a spot on the occiput, the flagellum *above*, the sutures surrounding the middle mesothoracic lobe, a minute spot on the disk of the lateral lobes, an elongate spot on the middle of the middle lobe, a delicate longi-

tudinal line down the center of the scutellum, a line in the mesopleural furrow, and a spot on the outer face of hind coxæ, near the middle, black.

The abdomen is conic-ovate, the dorsal segments narrowly banded with brown at base, the petiole hardly more than twice longer than thick. The hind femora are armed with about fourteen minute black teeth.

Type.—Cat. No. 7317 U. S. N. M.

Brazil: Bonito Prov. Pernambuco (Mr. Albert Koebele).

SPILOCHALCIS BIPUNCTATA, sp. nov.

Female.—Length 5.5 mm. Yellow; immaculate, except two black spots on the mesothorax (a spot on each lateral lobe) and two spots on the hind femora; flagellum brown. The abdomen is subglobose, the petiole short, hardly as long as wide. The hind femora are armed with ten or eleven small teeth.

Type.—Cat. No. 7318 U. S. N. M.

Brazil: Bonito Prov. Pernambuco (Mr. Albert Koebele).

XANTHOMELANUS Ashmead, gen. nov.

In this genus the metathorax is quadridentate posteriorly, two teeth on each side of the petiole; the plate at apex of the scutellum is emarginate or bidentate, while the hind femora are armed with several large teeth.

XANTHOMELANUS DIMIDIATUS (Fabricius).

(Plate XXXI., Fig. 5.)

Chalcis dimidata Fabricius, Syst. Piez., 1804, p. 160.—Dalla Torre, Cat. Hym., V., 1898, p. 387.

Conura dimidiata Sichel, Ann. Soc. ent. France (4), V., 1865, pp. 360, 390, ♀.

Smicra dimidiata Cresson, Trans. Am. Ent. Soc., IV., 1872, p. 56, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 376.

Smiera melanoptera Walker, Journ. Entom., I., 1861, p. 180, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 379.

Brazil: Venezuela; West Indies: Trinidad.

MELANOSMICRA Ashmead, gen. nov.

This genus in having the metathorax quadridentate agrees with *Xanthomelanus* but otherwise it is quite distinct. The scutellum is normal, unarmed; the antennæ are long, the scape reaching beyond the ocelli; while in its abdominal characters it shows some affinity with *Ceratosmicra*, only the petiole is not so long as in typical species. The black color of the head and thorax is characteristic.

MELANOSMICRA CLAVATA (Fabricius).

Chalcis clavata Fabricius, Syst. Piez., 1804, p. 162.—Dalla Torre, Cat. Hym., V., 1898, p. 387.

Brazil.

MELANOSMICRA IMMACULATA, sp. nov.

Male.—Length 5 mm. Head and thorax entirely black; scape of antennæ, the front and middle legs, the hind tarsi, and the long abdominal petiole, yellow; body of abdomen red; flagellum filiform, brown-black; while the hind legs, except the tarsi, are pale ferruginous.

Brazil: Chapada, in December.

Genus THAUMAPUS Kirby.

THAUMAPUS DECORUS (Walker).

Smiera decora Walker, Notes on Chalc., Pt. 3, 1871, p. 54, ♂.

Thaumapus decorus Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 56.—Dalla Torre, Cat. Hym., V., 1898, p. 403.

Brazil.

THAUMAPUS MASUS (Walker).

Smiera masus Walker, The Entom., I., 1841, p. 134, ♀ ♂.

Thaumapus masus Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 56.—Dalla Torre, Cat. Hym., V., 1898, p. 403.

Brazil.

THAUMAPUS WALKERI Kirby.

Thaumapus walkeri Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 74, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 403.

? *Smiera luteipennis* Walker, Journ. Entom., I., 1861, p. 173, ♀.

Brazil: St. Paulo (Mr. Bates).

THAUMAPUS ACUMINATUS, sp. nov.

Female.—Length 9 mm. Reddish-yellow; a line on the scape *above*, the flagellum, a triangular spot at apex of the scutellum and a transverse line at base, a spot on the lateral mesothoracic lobes, a curved line anteriorly on the middle lobe, interrupted medially, the extreme apex of the hind coxæ, the large femoral teeth, and some spots on the dorsum of the abdomen, black. The abdomen is long, lanceolate and ends in a long stylus. The hind femora are armed with six large teeth, the last tooth very large and tricuspidated.

Brazil: Santarem. One specimen.

Genus EPINÆUS Kirby.

EPINÆUS DUX (Walker).

Smiera dux Walker, Journ. Entom., I., 1861, p. 173, ♀.

Epinæus dux Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 58.—Dalla Torre, Cat. Hym., V., 1898, p. 395.

Brazil: Para (Bates).

ENNEASMICRA Ashmead, gen. nov.

In this genus the hind femora are armed with nine moderately large teeth and the scutellum is usually bidentate or emarginate at apex, rarely normal.

ENNEASMICRA EXINANIENS (Walker).

Smiera exinaniens Walker, Trans. Ent. Soc. London (3), II., 1864, p. 198, ♀.

Smicra exinaniens Dalla Torre, Cat. Hym., V., 1898, p. 377.

Brazil.

ENNEASMICRA CORUMBENSIS, sp. nov.

Female.—Length 6.5 mm. Yellow; a spot on the occiput, a small dot on the middle of the front face of the pronotum, an oblong spot on the inner margin of the lateral mesothoracic lobes anteriorly, two long triangular spots on the middle lobe anteriorly and a median line posteriorly, a spot at apex of the scutellum which is connected with a central line, the mesopleural furrow, a small spot on the hind coxæ near the base, and three spots on the hind femora, black. The abdomen is conic-ovate, the body brownish or fuscous above, the petiole hardly twice as long as thick and yellow. The hind femora are armed with nine large, black teeth, the last two more or less united at base.

Brazil: Corumba in April. One specimen.

ENNEASMICRA INCERTA, sp. nov.

Male.—Length 7 mm. Reddish golden brown; the flagellum, a large median spot on the front face of the pronotum, a transverse spot at apex of the scutellum and a transverse line at base, both being connected by a central line, a spot on the lateral mesothoracic lobes, a large triangular spot extending from the anterior margin of the middle lobe, and a spot at the apex of the metanotum, black. The abdomen is oblong-oval, the petiole a little more than three times as long as thick, the dorsal segments tinged with brown. The hind femora are about thrice as long as wide and armed with nine large, black teeth.

Brazil: Corumba, in May. One specimen.

Genus PROTOCERAS Kirby.

Protoceras caudatus (Guérin).

Chalcis caudatus Guérin, Iconogr. régn. anim., VII., Insect., 1845, p. 412; T. 6, f. 6.
Protoceras caudatus Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 60.—Dalla Torre, Cat. Hym., V., 1898, p. 370.

Brazil.

Protoceras leucotelus (Walker).

Smicra leucotelus Walker, Journ. Entom., I., 1861, p. 181, ♀.
Protoceras leucotelus Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 60.—Dalla Torre, Cat. Hym., V., 1898, p. 370.

Brazil.

OCTOSMICRA Ashmead, gen. nov.

This genus comes near *Protoceras* Kirby, agreeing with it in having the hind femora armed with eight large teeth, but differs in having the parapsidal furrows distinct, entire; the plate at the apex of the scutellum is emarginate or bidentate, while the abdomen, in the female, is lanceolate or conically produced, the eighth segment usually long or styliform.

Octosmicra attalica (Walker).

Smiera attalica Walker, Trans. Ent. Soc. London (3), II., 1864, p. 193, ♂.
Smicra attalica Dalla Torre, Cat. Hym., V., 1898, p. 375.

Brazil.

Octosmicra correcta (Walker).

Smiera correcta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 191, ♀.
Smicra correcta Dalla Torre, Cat. Hym., V., 1898, p. 375.

Brazil.

? Octosmicra referator (Walker).

Smiera referator Walker, Trans. Ent. Soc. London (3), I., 1862, p. 347, ♀.
Smicra referator Dalla Torre, Cat. Hym., V., 1898, p. 381.

Brazil.

Octosmicra nigroacmulata, sp. nov.

Male.—Length 8 mm. Yellowish-red; the scrobes, a dot on face, a dot on the clypeus, the teeth of mandibles, a spot on middle of the pronotum anteriorly, a large triangular spot on the middle mesothoracic lobe, a spot on each lateral lobe, a transverse spot at base of the scutellum, another near the apex, a spot at base of the metanotum connected with a median line, a line along the front margin of the mesopleura, the femoral furrow, and the flagellum, black. The triangular black spot on the middle mesothoracic lobe is interrupted by a reddish spot anteriorly. Wings hyaline, the veins testaceous. The hind femora are armed with eight teeth,

the teeth tipped with black; the first or basal tooth is long, acute, the following triangular, about equal in size.

Brazil: Chapada, in May. One specimen.

OCTOSMICRA TRIMACULATA, sp. nov.

Female.—Length 10 mm. Yellowish-red, with a spot on each lateral lobe of mesonotum and at the apex of the scutellum, black. The body of the abdomen is conically pointed, the terminal segment styliform, the sheaths of the ovipositor at apex and the ovipositor, black; the dorsal segments are stained with brown or blackish marks. The femoral furrow of the mesopleura has a black spot low down, but otherwise, except as noted, the thorax is immaculate. The hind femora are as in *O. nigromaculata*, except that the teeth, after the first, are not nearly equal in size, the second tooth being small, the eighth tridentate at apex or tricuspidated, so that the femora appear as if ten-dentate.

Brazil: Corumba in May. One specimen.

HEPTASMICRA Ashmead, gen. nov.

The hind femora in this genus are armed with seven large teeth, the second usually reduced in size and sometimes tricuspidate: the abdomen is fusiform or conically produced, rarely ending in a stylus; while the mandibles in the female are bidentate, in the male tridentate.

HEPTASMICRA ADSCITA (Walker).

Smiera adscita Walker, Trans. Ent. Soc. London (3), II., 1864, p. 193, ♀.
Smicra adscita Dalla Torre, Cat. Hym., V., 1898, p. 373.

Brazil.

HEPTASMICRA CAPTIVA (Smith).

Smiera captiva Smith, Trans. Ent. Soc. London (3), I., 1862, p. 42, ♀.
Smiera adaptata Walker, Trans. Ent. Soc. London (3), II., 1864, p. 190, —.
Smicra captiva Marshall, Ann. Soc. ent. France, LXI., 1892, p. 70; Pl. 4, f. 1.—Dalla Torre, Cat. Hym., V., 1898, p. 374.

Brazil: Maruru, in April; Venezuela: Corozal.

HEPTASMICRA CHYSOMERA (Walker).

Smiera chysomera Walker, Journ. Ent., I., 1861, p. 182, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 374.

Brazil: St. Paul (Mr. Bates).

HEPTASMICRA OBLITERATA (Walker).

Smiera obliterata Walker, Journ. Entom., I., 1861, p. 175, ♀ ♂.
Smicra obiterata Dalla Torre, Cat. Hym., V., 1898, p. 380.

Brazil: Santarem; Chapada; Corumba; Rio de Janeiro.

HEPTASMICRA PERSIMILIS, sp. nov.

Female.—Length 11 mm. Reddish-yellow, with black marks as in *H. lineaticoxis*, except that the black on the middle mesothoracic lobe is interrupted by a reddish-yellow spot anteriorly, the hind coxæ being immaculate, while the dorsal abdominal segments are banded with black.

The body of the abdomen is much larger and longer than in *H. lineaticoxis*, the petiole being about five times as long as thick.

Brazil: Santarem. One specimen.

HEPTASMICRA AFFINIS, sp. nov.

Female.—Length 9.2 mm. Colored as in *H. lineaticoxis*, except the back of the head, the forehead and the scrobes are wholly black; the hind coxæ have two black stripes instead of one; the hind femora have a black band at base, along the lower margin, besides a spot on the *inner* face; while the hind tibiæ, except at the basal third, are black.

The abdomen is totally different in shape; it is lanceolate, much longer than the head and thorax united, with a very short petiole, which is wider than long; the dorsal segments are banded with black.

Brazil: Santarem. Two specimens.

HEPTASMICRA LONGICAUDATA, sp. nov.

Female.—Length 8.5 mm. Colored as in *H. lineaticoxis*, except that the hind coxæ are immaculate except at extreme apex above, while the hind tibiæ are black or dark fuscous, with a yellowish annulus before the middle.

The abdomen is long, lanceolate and terminates in a long, compressed stylus, as long as the previous segments united; the petiole is very short, wider than long.

Brazil: Maruru, in April. One specimen.

HEPTASMICRA LINEATICOXUS, sp. nov.

Female.—Length 9.5 mm. Reddish-yellow; a transverse spot on the occiput, a spot in the frontal depression, the flagellum, a triangular spot on the scutellum extending from its apex, an oblong spot on the lateral mesothoracic lobes anteriorly, the middle mesothoracic lobe, except the outer margins broadly, the sheaths of the ovipositor, and a line on the hind coxæ *above*, black.

The body of the abdomen is long-ovate, the petiole very long, six or more times longer than thick. The hind femora are armed with seven large teeth, the first three very acute, the following broader and rounded at apex.

Brazil: Santarem. Four specimens.

HEPTASMICRA QUADRIMACULATA, sp. nov.

Male.—Length 6 mm. Yellow; a line on the scape *above*, the flagellum, two triangular spots on the anterior margin of the middle mesothoracic lobe, a small spot on each of the lateral lobes and the terminal ventral segment, black.

The abdomen is long-ovate, the petiole a little more than twice as long as thick; the dorsal segments are more or less marked with brown or fuscous stains. The hind femora are armed with seven black tipped teeth, all large, except the second, which is small.

Brazil: Corumba, in May.

Genus METADONTIA Ashmead.

METADONTIA FLAVOLINEATA, sp. nov.

Female.—Length 7 mm. Black; a dot between the ocelli, front orbits, cheeks pronotum above, a line on each side of the middle mesothoracic lobe, abbreviated posteriorly, a transverse line at base of the scutellum, another at apex, the metathorax, a spot beneath the tegulæ, the front legs from the tips of the femora, the middle tarsi, the hind coxæ, except apices and a broad line beneath, a transverse line near apex of hind femora both outwardly and inwardly, an annulus on the hind tibiæ near the middle, the abdomen at base, including the petiole and second segment, and an elongate spot at tip of abdomen *above*, yellow.

The ridge or plate at the apex of the scutellum is emarginate and wholly yellow.

Brazil: Santarem. One specimen.

Resembles *Metadontia* (*Chalcis*) *nigricornis* Fabr. but differs in the color of the hind legs and by the emarginate plate at apex of the scutellum.

METADONTIA SIMILIS, sp. nov.

Male.—Length 5 mm. Colored very much as in *M. flavolineata*, but the pronotum above, although yellow, has a black spot at the sides posteriorly; the scutellum is margined all around with yellow, the axillæ being black; the metathorax, except a central black spot, is yellow; the front and middle legs, except the first joint of the trochanters *above* and the base of the femora *above* for about two thirds their length, are yellow; the hind coxæ except at basal third are black: the hind femora are mostly yellow, but outwardly have a large black spot at base, connected with a black line beneath, above on the ridge is a black line at the basal two thirds, which itself is connected with a black line on the inner face: the inner face has also a black spot; the hind tibiæ are black except the apical two thirds of the *outer* face; the hind tarsi are yellow.

The abdomen is yellow, the dorsal segments banded with black.

Brazil: Santarem. One specimen.

Allied to *M. nigricornis* Fabr.

Metadontia affinis, sp. nov.

Female.—Length 6 mm. Black and marked with yellow much as in *M. similis.* The front orbits, the cheeks, scape entirely, pronotum above, except a small black spot on each side, a line on each side of the middle mesothoracic lobe clear to the base of the scutellum, the outer margins of the lateral lobes, the sides and apex of the scutellum, except a median black spot on the emarginate plate at apex, yellow.

The legs are as in *M. similis* except that the hind femora are black, with a curved yellow line on outer face near apex, the base being margined with yellow, within similarly marked; femoral teeth, two and three small, the others larger. The abdomen is mostly black, the petiole yellow, the second segment (first body) reddish except at apex above.

Brazil: Santarem. One specimen.

HEXASMICRA Ashmead, gen. nov.

In having the hind femora armed with six large teeth this genus comes nearest to *Metadontia* Ashm., but is easily separated from it by the totally different shaped abdomen, which is lanceolate or fusiform, longer than the head and thorax united, the petiole being short, not longer than thick. The scutellum at apex is usually bidentate or emarginate.

Hexasmicra transversa (Walker).

Smiera transversa Walker, Journ. Entom., I., 1861, p. 182, ♀ ♂.

Smicra transversa Dalla Torre, Cat. Hym., V., 1898., p. 383.

Brazil: Ega; Tapayos (Mr. Bates); Chapada; Santarem. Two female and seven male specimens.

? Hexasmicra trinidadensis, sp. nov.

Female.—Length 4 mm. Yellow; a transverse spot on the occiput, the flagellum above, a transverse line at base of scutellum, the femoral teeth and the apex of the hind tibiæ black. The abdomen is fusiform, the petiole at least five times as long as thick, the middle dorsal segments stained with black or fuscous. The hind femora are armed with six large teeth, the first four acute, the last two broad, rounded at apex.

West Indies: Trinidad.

? Hexasmicra brasiliensis, sp. nov.

Male.—Length 4 mm. Yellow; a transverse spot on the occiput, the flagellum, a transverse line on the anterior margin of the middle mesothoracic lobe and a deli-

cate median line posteriorly, a spot on the axillæ, a median line on the scutellum posteriorly and the femoral teeth, black. The abdomen is ovate, the petiole being about three times as long as thick. The hind femora are armed with six large teeth, all acute.

Brazil: Corumba, in May.

PENTASMICRA Ashmead, gen. nov.

In this genus the hind femora are armed with five large teeth; eyes large, occupying nearly the whole sides of the head; mandibles three-dentate; while the scutellum at apex is bidentate.

PENTASMICRA APERTA (Walker).

Smiera aperta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 187, ♀.
Smicra aperta Dalla Torre, Cat. Hym., V., 1898, p. 373.

Brazil.

PENTASMICRA APPRESSA (Walker).

Smiera appressa Walker, Trans. Ent. Soc. London (3), II., 1864, p. 186, ♀.
Smicra appressa Dalla Torre, Cat. Hym., V, 1898, p. 373.

Brazil.

PENTASMICRA BRASILICA (Walker).

Smiera brasilica Walker, Trans. Ent. Soc. London (3), II., 1864, p. 188, ♀.
Smicra brasilica Dalla Torre, Cat. Hym., V., 1898, p. 374.

Brazil.

PENTASMICRA CERINA (Walker).

Smiera cerina Walker, Trans. Ent. Soc. London (3), II., 1864, p. 187, ♂.
Smicra cerina Dalla Torre, Cat. Hym., V., 1898, p. 374.

Brazil.

PENTASMICRA CERTA (Walker).

Smiera certa Walker, Trans. Ent. Soc. London (3), II., 1864, p. 187, ♀.
Smicra certa Dalla Torre, Cat. Hym., V., 1898, p. 374.

Brazil.

PENTASMICRA COMMODA (Walker).

Smiera commoda Walker, Trans. Ent. Soc, London (3), II., 1864, p. 195, ♀.
Smicra commoda Dalla Torre, Cat. Hym., V., 1898, p. 374.

Brazil.

PENTASMICRA CONTEMINATA (Walker).

Smiera conteminata Walker, Trans. Ent. Soc. London (3), II., 1864, p. 194, ♀.
Smicra conteminata Dalla Torre, Cat. Hym., V., 1898, p. 375.

Brazil.

(?) PENTASMICRA EFFICTA (Walker).

Smiera efficta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 184, ♂.

Brazil: Amazon.

Pentasmicra scisa (Walker).

Smiera scisa Walker, Trans. Ent. Soc. London (3), II., 1864, p. 192, ♂.
Smicra scisa Dalla Torre, Cat. Hym., V., 1898, p. 381.

Brazil: Amazon.

TETRASMICRA Ashmead, gen. nov.

This genus is at once recognized by the hind femora being armed with four large teeth and by the scutellum being emarginate or bidentate at apex.

Tetrasmicra concitata (Walker).

Smiera concitata Walker, Trans. Ent. Soc. London (3), II., 1864, p. 183, ♀.
Smicra concitata Dalla Torre, Cat. Hym., V., 1898, p. 375.

Brazil: Amazon region.

Tetrasmicra crocata (Walker).

(Plate XXXII., Fig. 2.)

Smiera crocata Walker, Trans. Ent. Soc. London (3), II., 1864, p. 186, ♀.
Smicra crocata Dalla Torre, Cat. Hym., V., 1898, p. 375.

Brazil: Amazon region.

Tetrasmicra destinata (Walker).

Smiera destinata Walker, Trans. Ent. Soc. London (3), II., 1864, p. 185, ♀.
Smicra destinata Dalla Torre, Cat. Hym., V., 1898, p. 376.

Brazil.

Tetrasmicra maculata (Fabricius).

Chalcis maculata Fabricius, Mant. Ins., I., 1787, p. 273.—Gmelin, Linn. Syst. Nat., Ed. 13[a], I., 1790, p. 274.—Oliver, Encyc. Méthod. Ins., V., 1790, p. 440.—Fabricius, Ent. Syst., II., 1793, p. 198.—Fabricius, Syst. Piez., 1804, p. 162.
Smiera maculata Walker, The Entom., I., 848, p. 287.
Smicra maculata Cresson, Trans. Am. Ent. Soc., IV., 1872, p. 57.—Dalla Torre, Cat. Hym., V., 1898, p. 378.

Brazil.

TRISMICRA Ashmead, gen. nov.

In this genus the hind femora are armed with three large, strong teeth; otherwise it is similar to *Tetrasmicra*.

Trismicra contracta (Walker).

Smiera contracta Walker, Trans. Ent. Soc. London (3), II., 1864, p. 184, ♂.
Smicra contracta Dalla Torre, Cat. Hym., V., 1898, p. 375.

Brazil: Amazon region.

Tribe III. *Chalcitellini.*

No species is known in this tribe from South America.

Tribe IV. *Haltichellini.*

Genus HALTICHELLA Spinola.

Haltichella dorsalis Walker.

Haltichella dorsalis Walker, Journ. Entom., I., 1861, p. 185, ♀.
Halticella dorsalis Dalla Torre, Cat. Hym., V., 1898, p. 397.
Brazil.

Haltichella remotor Walker.

Haltichella remotor Walker, Trans. Ent. Soc. London (3), I., 1862, p. 367, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 398.
Brazil.

Genus CONURA Spinola.

Conura annulipes (Spinola).

Smicra annulipes Spinola, Mem. accad. sc. Torino (2), XIII., 1851, p. 44, ♀.
Conura annulipes Sichel, Ann. Soc. ent. France (4), V., 1865, pp. 360 and 394, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 403.
Brazil.

Conura flavicans Spinola.

Conura flavicans Spinola, Mag. de Zool., VIII., 1837, p. 180, ♀, T. 180.—Blanchard, Hist. nat. Ins., III., 1840, p. 256.—Sichel, Ann. Soc. ent. France (4), V., 1865, pp. 359 and 387, ♀.—Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 58; Pl. 3, f. 26 and 27.—Dalla Torre, Cat. Hym., V., 1898, p. 403.
Brazil.

Genus ANTROCEPHALUS Kirby.

Antrocephalus punctiger (Fabricius).

Chalcis punctiger Fabricius, Syst. Piez., 1804, p. 167.
Antrocephalus punctigera (Howard) Journ. Linn. Soc. London, Zool., XXV., 1894, p. 81, ♀ ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 396.
Brazil.

Genus ASPIRHINA Kirby.

Aspirhina dubitator (Walker).

Halticella dubitator Walker, Trans. Ent. Soc. London (3), I., 1862, p. 366.
Aspirhina dubitator Kirby, Journ. Linn. Soc. London, Zool., XVII., 1883, p. 60.—Dalla Torre, Cat. Hym., V., 1898, p. 399.
Brazil: Santarem.

Tribe V. *Dirhinini.*

Genus HONTALIA Cameron.

Hontalia cameroni, sp. nov.

(Plate XXXII., Fig. 4.)

Female.—Length 6.1 mm.; ovipositor 3.5 mm. Blue, with a slight greenish tinge the head and thorax coarsely punctate, the metanotum and the metapleura metallic green; abdomen æneous black, the petiole longitudinally striate, the second segment very large, smooth, impunctate, the following segments united not longer than the second and microscopically shagreened; eyes light brown; ocelli pale; antennæ brown; front and middle legs, except coxæ, ferruginous, the tarsi paler, more of a yellowish-white; hind legs æneous black, except the long coxæ which are bluish and the tarsi which are yellowish-white. Wings hyaline, tinged with yellowish, the veins light brown.

Brazil: Santarem. One specimen.

Named in honor of Mr. Peter Cameron.

Hontalia kirbyi, sp. nov.

(Plate XXXII., Fig. 5.)

Male.—Length 3.5 mm. Æneous black, reticulately punctate, the mesopleura with an opaque, shagreened depression that extends from the tegulæ to the middle coxæ, the metanotum with several carinæ; the hind tarsi, the front and middle legs, except coxæ, the thickened portion of the femora, and a large part of the tibiæ basally are honey-yellow or testaceous; the abdominal petiole is longitudinally striate, the second abdominal segment, except apically, being smooth and polished, the apex of the second segment and the following segments are finely microscopically punctate.

Brazil: Santarem. Two specimens.

Family LXIII. EURYTOMIDÆ.

Tribe I. *Aximini.*

Genus AXIMA Walker.

TABLE OF SPECIES.

1. Males 5

Females.

Wings hyaline, *without* a blackish band at base 2

Wings hyaline, *with* a broad blackish band at base.

Front legs, except tips of the tibiæ, red .... *A. spinifrons* Walker.

2. Pronotum not wholly black, red at the sides.......... 3
   Pronotum wholly black; frontal spines distinct but not acute.
   Antennæ, except a streak on the scape beneath and at base, and the legs, except knees, tibiæ and tarsi, black; knees, tibiæ and tarsi honey-yellow, the middle and hind tibiæ faintly dusky at the middle; abdomen wholly black.......... *A. koebelei*, sp. nov.
3. Frontal spines very minute, nearly obsolete.......... 4
   Frontal spines long, acute, twice longer than wide at base.
   Trochanters, knees, tips of tibiæ and tarsi, honey-yellow; abdomen with a reddish spot on sides of fourth and fifth segments.......... *A. brasiliensis*, sp. nov.
4. Face below antennæ, sides of pronotum, sides of the fifth abdominal segment and most of the sixth, red; trochanters, knees, tips of tibiæ and the tarsi, honey-yellow; antennæ rather short, black, except the scape at base; scutellum and metanotum sometimes reddish.......... *A. brevicornis*, sp. nov.
5. Frontal spines indistinct, nearly obsolete.......... 6
   Frontal spines distinct.......... *A. spinifrons* Walker.
6. Wholly black, except the legs, the knees, tibiæ and tarsi honey-yellow, the middle and hind tibiæ sometimes dusky or fuscous medially; antennæ long, the funicle joints long, contracted medially, each funicle joint with two whorls of long sparse hairs.......... *A. brevicornis*.

Axima spinifrons Walker.

Axima spinifrons Walker, Trans. Ent. Soc. London (3), I., 1862, p. 374.—Kirby, Journ. Linn. Soc. Zool., XVII., 1883, pl. 57; Pl. 3, f. 19.—Dalla Torre, Cat. Hym., V., 1898, p. 35.

Brazil: St. Paul.

Axima koebelei, sp. nov.

Female.—Length 4.5 mm. Black; scape beneath and basally, tegulæ, trochanters, knees, tips of tibiæ and the tarsi honey-yellow; pronotum, except a median stripe, and spots on sides of the fifth and the sixth abdominal segments, red.

The frontal spines are large, acute, and fully twice as long as wide at base.

Type.—Cat. No. 6394, U. S. N. M.

Brazil: Bonito Prov., Pernambuco. (Mr. Albert Koebele.)

Axima brasiliensis, sp. nov.

Female.—Length 4.5 mm. Resembles *A. koebelei*, but differs in color. It is black, with the face below the antennæ, the cheeks, the pronotum except a median stripe, the metathorax at apex and at sides, and the sides of the fourth and fifth abdominal segments, red; trochanters, knees, tips of tibiæ and the tarsi, honey-yellow.

Type.—Cat. No. 6395, U. S. N. M.

Brazil: Bonito Prov., Pernambuco. (Mr. Albert Koebele.)

Axima brevicornis, sp. nov.

Female.—Length 4 to 4.6 mm. Black; the face below the insertion of the antennæ, the sides of the pronotum, the prosternum, sometimes the metapleura and the

sides of the fifth and sixth abdominal segments, more or less, red; scape at base, tegulæ, trochanters, knees, tibiæ and tarsi, honey-yellow; the tibiæ are sometimes dusky except at tips. Wings hyaline, the veins brown.

The frontal spines are very minute, nearly obsolete, only represented by a carina close to the eye.

Male.—Length 3–4 mm. Black, with the second joint of the trochanters, the front tibiæ, usually entirely, the tips of middle and hind tibiæ, and all tarsi, honey-yellow. The flagellum in this sex is very long, extending to the apex of the abdominal petiole, the joints of the flagellum long, contracted at the middle, each joint of the funicle with two whorls of long hairs. The apex of the metathorax has a quadrate area just above the insertion of the petiole while the petiole is very long, narrowed towards apex, shagreened, and with some longitudinal ridges or carinæ.

Brazil: Chapada, in April; Corumba; Santarem.

Described from two female and five male specimens.

AXIMOPSIS Ashmead, gen. nov.

Allied to *Axima* Walker, but easily separated by the different venation and by the totally different shape of the abdomen. The marginal vein is much shorter than it is in *Axima*, being hardly twice the length of the stigmal vein, while the abdomen is much shorter, never long lanceolate, the relative length of the segments being totally unlike those in *Axima*, with a much shorter petiole. The head, too, is different, not so acutely horned, the lateral ocelli being nearer to the eye margin than to each other; in *Axima* the ocelli are nearer to each other than to the eye margin.

Aximopsis morio, sp. nov.

(Plate XXXII., Fig. 6.)

Female.—Length 4.2 mm. Black; the sutures between the femora and tibiæ, the extreme tips of tibiæ and the tarsi honey-yellow. Wings hyaline, bare, the tegulæ black, veins yellowish. The head is wider than the thorax, has a carina extending around the inner orbits, another bounded the scrobes and extending to the clypeus; otherwise it is much as in *Axima*, only not so transverse, the malar space being larger.

Tribe II. *Isosomini.*

Genus ISOSOMODES Ashmead.

Isosomodes brasiliensis, sp. nov.

(Plate XXXIII., Fig. 1.)

Female.—Length 3.5 mm. Black; the scape, pedicel, first joint of funicle, except sometimes at apex, the tegulæ, the trochanters, the tibiæ and the tarsi, honey-

yellow. Wings hyaline, the veins brownish-yellow. The abdomen is long, conic-ovate, a little longer than the head and thorax united, subcompressed, smooth and shining, the petiole short, rugose, not or hardly longer than thick.

Brazil: Corumba, in May; Santarem. Five specimens.

Isosomodes nigriceps, sp. nov.

(Plate XXXIII., Fig. 2.)

Male.—Length 4.5 mm. Brownish-yellow, the head *above*, the abdominal petiole, a spot at base of second dorsal abdominal segment, a spot at apex of the third and fourth dorsal segments, all the following segments *above*, black; eyes brown, the ocelli red. The head has a deep frontal channel; the antennæ are long, filiform, inserted a little above the middle of the face, the scape reaching beyond the ocelli, the pedicel of same being very short, the funicle joints long, about two thirds the length of the scape, briefly pedicellate and with two whorls of long, black hairs as in *Isosoma*.

Brazil: Santarem. One specimen.

Genus ISOSOMA Walker.

Isosoma orchidearum Westwood.

Isosoma orchidearum Westwood, Gardener's Chron., 1869, p. 330.—Westwood, Trans. Ent. Soc. London, 1882, p. 323, ♀ ♂; Pl. 13, f. 1. ♂, 4 ♀.—Fitch, Trans. Ent. Soc. London, 1884, Proc., p. xi.—MacLachlan, Trans. Ent. Soc. London. 1884, Proc., p. xiv.—Riley, Insect Life, I., 1898, p. 121.—Riley, Insect Life, II., 1890, pp. 250, 251.—Dalla Torre, Cat. Hym., V., 1898, p. 349.

Brazil: Living in buds of *Cattleya* sp.

This is probably not a true *Isosoma.*

Tribe III. *Eurytomini.*

Genus CHRYSEIDA Spinola.

Chryseida amazonica Westwood.

Chryseida amazonica Westwood, Thesaus. Ent. Oxon., 1874, p. 140; pl. 26, f. 5, ♀. —Dalla Torre, Cat. Hym., V., 1898, p. 352.

Brazil.

Chryseida cyanea (Fabricius).

Chalcis cyanea Fabricius, Syst. Piez., 1804, p. 164, ♀.

Chryseida cyanea Ashmead, Proc. Ent. Soc. Washington, III., 1895, p. 106, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 352.

Brazil: Chapada. A single female specimen taken in April.

Chryseida superciliosa Spinola.

Chryseida superciliosa Spinola, Mag. de Zool., X., 1840, p. 12. ♀, T. 42.—Rev. Zool., 1840, p. 18.—Westwood, Thesaur. Ent. Oxon., 1874, p. 140.—Dalla Torre, Cat. Hym., V., 1898, p. 352.

British Guiana.

Chryseida æneiventris, sp. nov.

(Plate XXXIII., Fig. 3.)

Female.—Length 6 mm. Head and thorax blue, coarsely punctate, the disk of the metathorax, the mesopleura, coxæ, and the punctures along the eyes and on the face, metallic green; flagellum black, the basal two thirds of the scape at least beneath, yellow; third joint of the flagellum fully three and one half times as long as thick, legs rufous, the coxæ metallic greenish, the tarsi yellowish; abdomen æneous or bronzed, the last segment bluish. Wings hyaline, the veins yellowish.

Brazil: Santarem; Chapada, in April.

Genus BEPHRATA Cameron.

Bephrata striatipes, sp. nov.

(Plate XXXIII., Fig. 4.)

Female.—Length 6.5 mm. Black, coarsely punctate; the face, except the scrobes, the cheeks, the temples, a large oblong spot on each side of the pronotum, the tegulæ, and the legs, except black stripes on the front and middle femora *above*, and the hind femora which are black, except at tips, are yellow. Wings hyaline, with a fuscous cloud beneath the marginal vein.

The abdomen is much compressed, about as long as the head and thorax united; seen from the side it is nearly as wide as long, the eighth segment represented by an aculeus; the fourth and fifth segments have a band of faint punctures before the middle, the sixth segment is punctured along the base, while the seventh segment is punctured towards the apex.

Brazil: Para, in June. Two specimens.

AXIMOGASTRA Ashmead, gen. nov.

This genus comes nearest to *Bephrata* Cameron, but is easily separated by the totally different shape of the abdomen which is long-lanceolate and compressed, much as in *Axima* Walker, by the first joint of the funicle, although long, being shorter than the scape, and by the venation, which is nearly as in *Isosoma* Walker

AXIMOGASTRA BAHIÆ, sp. nov.

(Plate XXXIII., Fig. 5.)

Female.—Length 5.5 mm. Yellow, umbilicately punctate; a large spot on dorsum of pronotum posteriorly, a stripe on the scutellum, the mesopleura medially, and the metathorax, black. Wings hyaline, the veins yellowish. The long, lanceolate, much compressed abdomen, which is longer than the head and thorax united, is yellow, with some of the dorsal segments marked with black, the last two segments being mostly black.

Type.—Cat. No. 7342 U. S. N. M.

Brazil: Bahia. Collected by Mr. Albert Koebele, March 19, 1883.

PRODECATOMA Ashmead, gen. nov.

This is another singular genus. In its cephalic and thoracic characters it resembles *Decatoma* Spinola, while in venation and in its abdominal characters it is not unlike *Eurytoma* Illiger. Both mandibles are three-dentate, the two outer teeth acute, the inner tooth blunt; the marginal vein is long, slender, the postmarginal being very long, much longer than the marginal, while the stigmal vein, with its knob, is only about half as long as the marginal; the abdomen is compressed, not or hardly longer than the head and thorax united, usually shorter; seen from the side it is broadly oval or short ovate, usually pointed at apex, the petiole being slender and either short or long; the hind tibiæ are fringed with stiff bristles behind as in *Decatoma*.

PRODECATOMA BRUNEIVENTRIS, sp. nov.

Female.—Length 3.5 mm. Head and thorax yellow, immaculate, umbilicately punctate; abdomen brownish; the flagellum and eyes brown black; the ocelli are placed nearly in a straight line and are sometimes encircled with black. The first joint of the flagellum is more than thrice as long as thick, the following imperceptibly shortening to the club. Legs yellow, except the apical half of the hind tibiæ which is fuscous. Wings hyaline, the veins light brown. The abdomen is short, compressed; seen from the side it is oval and hardly longer than the thorax, acutely pointed at apex.

Male.—Length 2.1 mm. Yellow, with the upper part of the head, the thorax above and the abdomen, black; the flagellum is black, the funicle joints long, contracted at the middle, each joint with two whorls of long hairs; legs yellow, with the apex of hind femora and the apical two thirds of hind tibiæ black.

Brazil: Chapada, in April and August; Santarem. Four specimens.

PRODECATOMA FLAVESCENS, sp. nov.

(Plate XXXIII., Fig. 6.)

Female.—Length 1.5 mm. Yellow, the legs much paler, the eyes brown. The first joint of the flagellum is about twice as long as thick, the second about two thirds the length of the first, the third oval, only a little longer than thick. Wings hyaline, the veins yellowish. The abdomen is subcompressed, shorter than the thorax, the petiole longer than thick.

Brazil. One specimen.

PRODECATOMA THORACICA, sp. nov.

Female.—Length 3.1 mm. The upper part of the head, the occiput, dorsum of pronotum, metathorax and the abdomen, except a spot on the sides of the fifth and sixth segments, are black, rest of body yellow, the club of the antennæ, a spot towards apex of the hind femora and the middle of the hind tibiæ being fuscous. Wings hyaline, the veins yellowish. The first joint of the funicle is long, about three and one half times as long as thick, the second a little more than twice as long as thick, the third about twice as long as thick, the following still shorter.

Brazil: Santarem. One specimen.

PRODECATOMA NIGRA, sp. nov.

Female.—Length about 4 mm., the abdomen acutely pointed. Wholly black, except the legs, which are yellow, with the coxæ black, the femora more or less black or brown, except at tips, eyes brown: ocelli red.

Brazil: Santarem.

Genus EURYTOMA Illiger.

EURYTOMA ARGENTATA Cameron.

Eurytoma argentata Cameron, Biol. Centr.-Am. Hym., I., 1884, p. 108.—Dalla Torre, Cat. Hym., V., 1898, p. 334.

Guyana.

EURYTOMA CUCLUS Walker.

Eurytoma cuclus Walker, Monogr. Chalc., II., 1839, p. 62, ♀♂.—Dalla Torre, Cat. Hym., V., 1898, p. 336.

Brazil: Bahia.

EURYTOMA PHILAGER (Walker).

Decatoma philager Walker, Monogr. Chalc., II., p. 81, ♂.

Eurytoma philager Walker, List. Chalc., Brit. Museum, I., 1846, p. 10.—Dalla Torre, Cat. Hym., V., 1898, p. 341.

Chile: Chiloe.

(?) EURYTOMA MELLEA Westwood.

Eurytoma mellea Westwood, Thesaur. ent. Oxon., 1874, p. 139; Pl. 26, f. 2.—Dalla Torre, Cat. Hym., V., 1898, p. 339.

Brazil: Para.

EURYTOMA MENON Walker.

Eurytoma menon Walker, Monogr. Chalc., II., 1839, p. 62, ♀♂.—Dalla Torre, Cat. Hym., V., 1898, p. 339.

Brazil: Bahia.

EURYTOMA POMORUM (Fabricius).

Chalcis pomorum Fabricius, Syst. Piez., 1804, p. 163.

Eurytoma pomorum Westwood, Thesaur. ent. Oxon., 1874, p. 138.—Dalla Torre, Cat. Hym., V., 1898, p. 341.

Brazil.

EURYTOMA PALLIDICEPS Spinola.

Eurytoma pallidiceps Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 467, ♀♂. —Dalla Torre, Cat. Hym., V., 1898, p. 340.

Chile.

EURYTOMA SIMPLEX (Fabricius).

Chalcis simplex Fabricius, Syst. Piez., 1804, p. 164.—Dalla Torre, Cat. Hym., V., 1898, p. 392.

Brazil.

Genus EUDOXINNA Walker.

EUDOXINNA TRANSVERSA Walker.

(Plate XXXIV., Fig. 1.)

Sosxetra transversa Walker, Trans. Ent. Soc. London (3), I., 1862, p. 37, ♀.

Eudoxinna transversa Walker, Trans. Ent. Soc. London (3), II., 1864, p. 207.—Westwood, Thes. ent. Oxon., 1874, p. 138; Pl. 25, f. 9, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 352.

Brazil: Ega; Benevides in July. One female.

In the Herbert H. Smith collection is a single male, taken at Chapada in April, which I think is the male of this species. It measures only 3.2 mm., is yellow with a spot on the vertex enclosing the ocelli, a spot at apex of scutellum, a spot at apex of the hind femora, the apical two thirds of the hind tibiæ, a stripe along the petiole above, and the body of abdomen *above*, black. The antennæ are inserted far up on the face, the scape being long and extending beyond the ocelli, with a minute tooth at apex *beneath;* the flagellum is similar to that in the males of *Isosoma*, each of the funicle joints having two whorls of long hairs. The abdomen is longly peti-

olated, the petiole being as long as the hind femora, the body being small, triangular in outline, the third segment being the largest segment.

Genus SYSTOLODES Ashmead.

Systolodes brasiliensis, sp. nov.

Female. — Length 1.5 mm. Black, the scape and the legs, except the coxæ and the hind femora, honey-yellow. Wings hyaline, the veins pale yellowish.

The joints of the funicle are a little longer than thick, the first joint being a little the longest. The abdomen is subglobose, subcompressed, the petiole being slender and as large as the hind coxæ.

Brazil: Chapada, in April. One specimen. Differs from all other species placed in this genus by the long abdominal petiole.

Tribe IV. *Rileyini.*

NEORILEYA Ashmead, gen. nov.

Head transverse, not wider than the thorax at its widest part, the eyes large, broadly oval or subrotund, the malar space very short; mandibles short, broad, 4-dentate; antennæ thirteen-jointed, with two ring-joints, alike in both sexes, the flagellum being stout, filiform, pubescent, stoutest in the female, the pedicel shorter than the first joint of the funicle; first two joints of the funicle in the male are submoniliform. Thorax robust, the pronotum very large, subquadrate, as wide as the mesonotum or very nearly, the latter being a little the longer, with the parapsidal furrows usually vaguely defined, rarely sharply defined or complete; the metathorax is extremely short. Abdomen short oval, shorter than the thorax, depressed, wider than deep, subsessile, the petiole very short, the first and third body segments the longest, nearly equal, the second very short, the fourth and the fifth longer than the second, the following more or less retracted.

In sculpture this genus agrees with *Eurytoma*, being umbilicately punctate.

Neorileya flavipes, sp. nov.

(Plate XXXVI., Fig. 2.)

Female.—Length 2.3–2.6 mm. Robust, black, umbilicately punctate, the abdomen oval, slightly depressed and delicately shagreened; scape and legs pale yellowish, rarely with the hind femora and tibiæ toward apex blackish, or dusky; flagellum filiform, the funicle joints two to six quadrate. Wings hyaline, the tegulæ and veins yellowish or brownish-yellow. The male is usually smaller, with

the abdomen more depressed, the pedicel as well as the scape being yellow; otherwise it is hardly distinguishable from the female.

Brazil: Chapada; Santarem. Ten specimens.

Genus RILEYA Ashmead.

RILEYA ORBITALIS, sp. nov.

Female.—Length 2 mm. Head and thorax, except the pronotum which is more or less brownish or yellowish, mostly black, the abdomen brown, the apex black; orbits, face below antennæ, scape, tegulæ, and the legs, except the basal half of the hind femora, yellow or brownish-yellow, the tips of the tibiæ and the tarsi paler or yellowish-white; flagellum subclavate, light brown, joints five and six of funicle wider than long. Wings hyaline, the veins pale yellowish; the marginal vein is a little more than twice the length of the stigmal, the postmarginal vein being long,

The abdomen is conic-ovate, cylindrical, nearly twice the length of the thorax, pointed at apex, the third segment very large, occupying the greater part of the whole surface of abdomen.

Brazil: Santarem.

FAMILY LXIV. PERILAMPIDÆ.

Genus PERILAMPUS Latreille.

PERILAMPUS BRASILIENSIS, sp. nov.

(Plate XXXIV., Fig. 4.)

Female. — Length 4.8–5 mm. Blue, the head behind the ocelli, the fore part of the middle mesothoracicl obe, and the inner front angle of the lateral lobes æneous; the head is smooth with several longitudinal striæ between the eyes and the scrobes, the pronotum coarsely, irregularly punctate, the middle mesothoracic lobe and the scutellum coarsely transversely striate, the lateral mesothoracic lobes with some long, oblique striæ posteriorly. The extreme tips of the tibiæ and the tarsi are testaceous.

Brazil: Chapada, in April. Two specimens.

FAMILY LXV. EUCHARIDÆ.

Genus EUCHARIS Latreille.

EUCHARIS DICERODERA Spinola? = *Kapala.*

Eucharis dicerodera Spinola, Mem. Acad. Sc. Torino (2), XIII., 1851, p. 43, ♂.— Dalla Torre, Cat. Hym., V., 1898, p. 360.

Brazil.

Genus ORASEMA Cameron.

Orasema festiva (Fabricius).

Eucharis festiva Fabricius, Syst. Piez., 1804, p. 157.

Orasema festiva Kirby, Journ. Linn. Soc. London, Zool., XX., 1886, p. 29.— Dalla Torre, Cat. Hym., V., 1898, p. 361.

Brazil.

Orasema rapo (Walker).

(Plate XXXIV., Fig. 5.)

Eucharis rapo Walker, Monogr. Chalc., II., 1839, p. 66, ♀.

Orasema rapo Kirby, Journ. Linn. Soc. London, Zool., XX., 1886, p. 26. — Dalla Torre, Cat. Hym., V., 1898, p. 361.

Brazil: Chapada, in April; Santarem; Corumba, in May. Fifteen specimens.

PSEUDOCHALCURA Ashmead, gen. nov.

This genus resembles *Chalcura* Kirby, but the wings are hyaline, *without* a fuscous spot, and the antennæ, in the male, have only *four* branches.

Pseudochalcura nigrocyanea, sp. nov.

(Plate XXXIV., Fig. 6.)

Male.— Length 3.5 mm. Blue-black, coarsely, reticulately punctate, with a faint æneous tinge above, the trochanters, apices of femora and all tibæ and tarsi, and the scape and pedicel of antennæ honey-yellow, the flagellum brown-black or brown, paler towards apex, joints one to four each with a long branch above. The abdomen is æneous black, with a very long petiole, the length of the hind femora, the body subcompressed, viewed from the side subtriangular.

Female. — Length about 4 mm. Agrees fairly well with the male except that the flagellum is brown, joints one to four acutely lobed above, while the abdomen is larger, the petiole much shorter, being hardly two thirds the length of the hind femora.

Brazil: Chapada, in April. Six specimens.

Genus STIBULA Spinola.

Stibula nigriceps, sp. nov.

(Plate XXXV., Fig. 2.)

Male.— Length 3 mm. Brownish-yellow, the head, except the eyes which are brown, being entirely black; the flagellum from the second joint is brown-black, the scape, pedicel, and the first joint of the flagellum being yellow; the first joint of the flagellum is very long, more than twice as long as the scape.

The thorax is brownish-yellow marked with black as follows: The middle mesothoracic lobe has two oblong, nearly confluent, spots anteriorly, the lateral lobes have a spot above, while the scutellum has a transverse line across the base and a central line ending on the two spines at the apex of the scutellum, black. The abdominal petiole and the legs are yellow.

Brazil: Santarem, in April. One specimen.

Genus SCHIZASPIDEA Westwood.

SCHIZASPIDEA MACULATA Westwood.

Schizaspidea? maculata Westwood, Thesaur. ent. Oxon., 1874, p. 153, ♀; Pl. 28, f. 1.

Orasema maculata Kirby, Journ. Linn. Soc. London, Zool., XX., 1886, p. 29.—Dalla Torre, Cat. Hym., V., 1898, p. 361.

Brazil.

SCHIZASPIDEA PRETENDENS Walker.

Schizaspidea pretendens Walker, Trans. Ent. Soc. London (3), I., 1862, p. 385, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 364.

Brazil: Chapada, in May. One specimen, badly damaged.

Genus TETRAMELIA Kirby.

TETRAMELIA MERIDIONALIS Kirby.

Tetramelia meridionalis Kirby, Ann. and Mag. Nat. Hist. (6), IV., 1889, p. 144, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 364.

Brazil.

TETRAMELIA PLAGIATA (Walker).

(Plate XXXV, Fig. 1.)

Schizaspidia plagiata Walker, Trans. Ent. Soc. London (3), I., 1862, p. 385, ♂.—Westwood, Thesaur. ent. Oxon., 1874, p. 152; Pl. 28, f. 11.

Tetramelia plagiata Kirby, Journ. Linn. Soc. London, Zool., XX., 1886, p. 31.—Dalla Torre, Cat. Hym., V., 1898, p. 364.

Brazil: Chapada, in November. One male specimen.

Genus THORACANTHA Latreille.

THORACANTHA LATREILLEI Guérin.

Thoracantha latreillei Guér. Iconogr. Régn. an. Ins., VII., 1829–44, p. 415; Pl. LXVII., f. 8.—Blanchard, Hist. nat. Ins., III., 1840, p. 257.—Walker, Ann. & Mag. Nat. Hist., XII., 1843, p. 45, ♀.—Kirby, Journ. Linn. Soc. London Zool., XX., 1886, p. 32.—Dalla Torre, Cat. Hym., X., 1898, p. 365.

Thoracantha coleopteroides (Waterhouse) Westwood, Trans. Ent. Soc. London, II., 1839, p. 196.

Galearia violacea Brullé, Hist. nat. Ins., Hym., IV., 1846, p. 572.

Thoracantha apta Walker, Trans. Ent. Soc. London (3), I., 1862, p. 384, ♂.— Westwood, Thesaur. ent. Oxon., 1874, p. 153 ; Pl. 28, f. 3.

Acrostela apta Shepp, The Entom., XXVI., 1894, p. 188.— Dalla Torre, Cat. Hym., V., 1898, p. 366.

Brazil : Santarem and Villa Nova ; Chapada, in March, April and November; Santarem. Twelve male and two female specimens.

THORACANTHA ROMANDII Guérin.

Thoracantha romandii Guérin, Iconogr. Règne anim., VII., Ins., 1845, p. 415.— Dalla Torre, Cat. Hym., V., 1898, p. 366.

Colombia.

Genus UROMELIA Kerby.

UROMELIA STRIATA (Perty).

Thoracantha striata Perty, Delect. anim. artic. Brasil, 1833, p. 134 ; T. 28, f. 15 and 16. — Blanchard, Hist. nat. Ins., III., 1840, p. 257.

Uromelia striata Kirby, Journ. Linn. Soc. London, Zool., XX., 1886, p. 37. — Dalla Torre, Cat. Hym., V., 1898, p. 367.

Thoracantha flabellatus Westwood, Proc. Soc. London, III., 1835, p. 52, ♂.

Thoracantha aculeata Westwood, *opus cit.*, 1835, ♀.

Chalcis (*Thoracantha*) *aculeata* Blanchard, Cuvier : Règne anim., Ed. 3ª, Ins., II. 1849 ; T. 113, f. 8.

Thoracantha aculeata Westwood, Thesaur. ent. Oxon., 1874, p. 154 ; Pl. 28, f. 9.

Lasionychus flabellatus Shipp, The Entom., XXV., 1894, p. 188. — Dalla Torre, Cat. Hym., V., 1898, p. 367.

Brazil : Santarem. Five specimens.

Genus DICŒLOTHORAX Ashmead.

Allied to *Lætocantha* Shipp, but easily distinguished by the deep impressions on the mesonotum and the scutellum, and by the very broad and different shape of the scutellar processes, which form a broad shield over the abdomen.

DICŒLOTHORAX PLATYCERUS, sp. nov.

(Plate XXXV., Fig. 3.)

Female. — Length 3.8 mm. Æneous black, the antennæ, the legs, except the coxæ and a median longitudinal stripe on the closely united scutellar projections, testaceous. The disk of the mesonotum and the scutellum are concavely excavated, the bottom of the concavities being smooth and highly polished, the scutellar processes being longitudinally striated. The pronotum is greatly elevated and coarsely

transversely striated. The head is coarsely shagreened, with some irregular elevated lines. The antennæ are short, the first joint being very long, clavate, about the length of the scape, or nearly as long as all remaining joints united, the second funicle joint only a little longer than thick, the following transverse.

The male differs from the female only slightly in the antennæ. The first joint of the flagellum is a little shorter about the length of the flagellum, the funicle joints two to four being much wider, subdentate *above.*

Brazil: Santarem. Two specimens.

Genus DILOCANTHA Shipp.

DILOCANTHA FLAVICORNIS (Walker).

Thoracantha flavicornis Walker, Trans. Ent. Soc. London (3), I., 1862, p. 382.—Westwood, Thesaur. ent. Oxon., 1874, p. 153; Pl. 28, f. 3.

Dilocantha flavicornis Shipp, The Entom., XXVII., 1894, p. 184.—Dalla Torre, Cat. Hym., V., 1898, p. 366.

Brazil: Villa Nova (Bates).

Genus ISOMERALIA Shipp.

ISOMERALIA CORONATA (Westwood).

Thoracantha coranata Westwood, Thesaur. ent. Oxon., 1874, p. 154; Pl. 28, f. 10.

Isomeralia coranata Shipp., The Entom., XXVII., 1894, p. 188.—Dalla Torre, Cat. Hym., V., 1898, p. 366.

Brazil: Bonito Provence, Pernambuco (Albert Koebele).

Genus LIRATA Cameron.

LIRATA BATESELLA (Westwood).

Thoracantha batesella Westwood, Thesaur. ent. Oxon., 1874, p. 154; Pl. 28, f. 8, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 365.

Brazil: Santarem. One male specimen.

LIRATA PALLESCENS (Walker).

Thoracantha pallescens Walker, Trans. Ent. Soc. London (3), I., 1862, p. 380, ♂.

Lirata pallens Shipp, The Entom., XXVII., 1894, p. 188.—Dalla Torre, Cat. Hym., V., 1898, p. 367.

Brazil: Villa Nova (Bates); Chapada, in March and November. Four specimens, two males.

The female has not been described. It may be easily recognized by the difference in the antennæ; the first joint of the funicle is very long, as long or a little longer than the scape, or nearly as long as all the remaining joints united, acute at apex above, joints two to four of funicle short but also acute at apex above.

LIRATA SURGENS (Walker).

Thoracantha surgens Walker, Trans. Ent. Soc. London (3), I., 1862, p. 384, ♂.

Lirata surgens Shipp, The Entom., XXVII., 1894, p. 188.—Dalla Torre, Cat. Hym., V., 1898, p. 367.

Brazil: Santarem.

Genus KAPALA Cameron.

KAPALA ALTA (Walker).

Thoracantha alta Walker, Trans. Ent. Soc. London (3), I., 1862, p. 383, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 365.

Brazil.

KAPALA ANCHURA (Walker).

Thoracantha anchurus Walker, List Chalc. Brit. Mus., I., 1846, p. 88.—Dalla Torre, Cat. Hym., 1898, p. 365.

Brazil.

KAPALA FURCATA (Fabricius).

Eucharis furcata Fabricius, Syst. Piez., 1804, p. 158, ♀.—Latreille, Gen. Crust. et Ins., III., 1807, p. 21.—Lamarck, Hist. nat. anim. s. vert., IV., 1817, p. 160.—Lamarck, *opus cit.*, Ed. 2ª, IV., 1835, p. 370.—Walker, Monogr. Chalc., II., 1839, p. 65.

Eucharis flabellatus Fabricius, Syst. Piez., 1804, p. 158, ♂.

Thoracantha furcata Walker, The Entom., I., 1841; Pl. 9, f. 2.

Chirocerus furcatus Brullé, Hist. nat. Ins. Hym., IV., 1846, p. 571; T. 38, f. 5.—Lucas, La Sagra's Hist. fis., etc., Cuba., VII., 1856, p. 762.—Desmarest, Chenu. Encycl. hist. nat. Annelles, 1860, p. 161; fig. 141.

Schizaspidia furcata Walker, Notes on Chalc., Pt. 4, 1871, p. 66, f. 2.—Walker, The Entom., VI., 1872, p. 88, fig.

Kapala furcata Cameron, Biol. Centr.-Am. Hym., I., 1884, p. 103; Pl. 5, f. 15.—Dalla Torre, Cat. Hym., V., 1898, p. 365.

Brazil: Chapada, in May and April; Santarem. Six female and four male specimens.

When in Berlin in the winter of 1889–90, I saw specimens of this species bearing MS. names: *Thoracantha elevata* Westw., *T. spinosa* Illiger, etc.

KAPALA INEXAGENS (Walker).

Thoracantha inexagens Walker, Trans. Ent. Soc. London (3), I., 1862, p. 381, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 365.

Brazil: Santarem (Bates); Chapada, in May. One specimen.

I am inclined to think this species is only a variety of *K. furcata* Fabr.

KAPALA ATRATA (Walker).

Thoracantha atrata Walker, Trans. Ent. Soc., London (3), I., 1862, p. 383, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 365.

Brazil.

KAPALA CYNIPSEA (Walker).

Thoracantha cynipsea Walker, Trans. Ent. Soc. London (3), I., 1869, p. 379, ♀♂.—Dalla Torre, Cat. Hym., V., 1898, p. 365.

Brazil: Santarem, Villa Nova.

KAPALA DICERODERA (Spinola).

Eucharis dicerodera Spinola, Mem. accad. sc. Torino (2), XIII., 1851, p. 43, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 360.

Brazil: Para.

KAPALA REFLEXA (Walker).

Thoracantha reflexa Walker, Trans. Ent. Soc. London (3), I., 1862, p. 382, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 366.

Brazil: Santarem (Mr. Bates).

KAPALA ROMANDII (Guérin).

Thoracantha romandii Guér. Iconogr. règn. anim., VIII., Ins., 1845, p. 415.—Dalla Torre, Cat. Hym., V., 1898, p. 366.

Colombia.

KAPALA STRIATISSIMA (Walker).

Thoracantha striatissima Walker, Trans. Ent. Soc. London (3), I., 1862, p. 380, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 366.

Brazil: Santarem (Mr. Bates).

KAPALA SPLENDENS sp. nov.

(Plate XXXV., Fig. 4.)

Female.—Length 8–8.5 mm. Very robust, the head and thorax brilliant metallic green, the abdomen blue or blue green, with æneous reflections, usually brassy above, the antennæ and the legs except the coxæ, yellowish, the wings subfuscous, the veins brown. The face is longitudinally striate, the striæ becoming transverse below the insertion of the antennæ, the thorax coarsely transversely striate, the scutellum and the scutellar processes longitudinally striate.

Brazil: Chapada, in April and November. Four specimens.

This is the largest and most brilliant of any Eucharid yet discovered.

Genus LASIOKAPALA Ashmead.

Allied to *Kapala* Cameron, but easily distinguished by being hairy or pubescent, and by the smoothness of the head. The lateral lobes of the mesonotum and the

scutellum, including the long processes, are also smooth, not striate; the scutellar processes are transversely striate or serrate at their apices.

Lasiokapala serrata, sp. nov.

(Plate XXXV., Fig. 5.)

Female.—Length 3.5 mm. Æneous black; the antennæ, the long scutellar processes and the legs are honey-yellow. The head in front is smooth without striæ; the thorax is hairy or pubescent, perfectly smooth, except the middle mesothoracic lobe above which is coarsely, transversely striate; the middle lobe and the scutellum have a deep depression on their disks; while the long scutellar processes are smooth to near their apices, their apices or tips above are laterally transversely striate or serrate.

Brazil: Chapada.

Family LXV. MISCOGASTERIDÆ.

Subfamily I. Pireninæ.

Genus HERBERTIA Howard.

Herbertia howardi, sp. nov.

(Plate XXXV., Fig. 6.)

Female.—Length 2.4 mm. Blue black, the thorax above with a slight æneous tinge; eyes very large, brown, pubescent; scape honey-yellow, the flagellum brown-black; tibiæ and tarsi pale yellow. The head and thorax above are shagreened or feebly punctate, pubescent; the mesopleuron has a broad, rather deep sulcus; the wings are hyaline, the veins brownish, the stigmal vein very small, the marginal vein very long, while the postmarginal vein is also long. The abdomen is ovate, a little longer than the thorax, the first body segment being the longest and occupying nearly the half of the whole surface, the following segments very short, subequal in length.

Brazil: Rio de Janeiro in August. One specimen.

Herbertia brasiliensis, sp. nov.

Female.—Length 1.6 mm. Head and thorax bluish, the abdomen æneous black; ocelli reddish-yellow; eyes large, hairy; flagellum brown-black; tibiæ and tarsi yellowish-white. The head and the thorax are only feebly shagreened, the lateral mesothoracic lobes being almost smooth; the wings are hyaline, the veins as in *H. howardi* except paler in color. The abdomen is ovate, pointed at apex, on

account of the sheaths of the ovipositor projecting slightly, but not longer than the thorax.

Brazil: Chapada, in April.

Subfamily II. Tridyminæ.

Tribe I. *Tridymini.*

Genus GASTRANCISTRUS Westwood.

Gastrancistrus cephalon Walker.

Gastrancistrus cephalon Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 30, ♀. — Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 461, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 203.

Chile: Conception (C. Darwin).

Gastrancistrus fulginas Walker.

Gastrancistrus fulginas Walker, Monogr. Chalc., II., 1839, p. 85, ♀. — Dalla Torre Cat. Hym., V., 1898, p. 203.

Chile: Chiloe.

Gastrancistrus polles Walker.

Gastrancistrus polles Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 186, ♀. — Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 460, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 204.

Chile: Coquimbo (C. Darwin).

Gastrancistrus vonones Walker.

Gastrancistrus vonones Walker, Monogr. Chalcid., II., 1839, p. 67, ♂ — Dalla Torre, Cat. Hym., V., 1898, p. 205.

Brazil: Bahia.

Genus ÆPOCERUS Mayr.

Æpocerus emarginatus Mayr.

Æpocerus emarginatus Mayer, Verh. zool.-bot. Gesell. Wien., XXXV., 1885, p. 244, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 315.

Brazil: St. Catharina (Dr. Fritz Müller).

Æpocerus excavatus Mayr.

Æpocerus excavatus Mayr., Verh. zool.-bot. Gesell. Wien., XXXV., 1885, p. 243, ♀♂. — Dalla Torre, Cat. Hym., V., 1898, p. 315.

Brazil: St. Catharina (Dr. Fritz Müller).

Æpocerus flavomaculatus Mayr.

Æpocerus flavomaculatus Mayr, Verh. zool.-bot. Gesell. Wien., XXXV., 1885, p. 244, ♂. — Dalla Torre, Cat. Hym., V., 1898, p. 316.

Brazil: St. Catharina (Dr. Fritz Müller).

Æpocerus inflaticeps Mayr.

Æpocerus inflaticeps Mayr, Verh. zool.-bot. Gesell. Wien., XXXV., 1885, p. 245; T. 16, f. 45.— Dalla Torre, Cat. Hym., V., 1898, p. 316.

Brazil: St. Catharina (Dr. Fritz Müller).

Æpocerus punctipennis Mayr.

Æpocerus punctipennis Mayr, Verh. zool.-bot. Gesell. Wien., XXXV., 1885, p. 245, ♂.— Dalla Torre, Cat. Hym., V., 1898, p. 245.

Brazil: St. Catharina (Dr. Fritz Müller).

Æpocerus simplex Mayr.

Æpocerus simplex Mayr, Verh. zool.-bot. Gesell. Wien., XXXV., 1885, p. 244, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 316.

Brazil: St. Catharina (Dr. Fritz Müller).

Tribe II. *Metastenini.*

Genus LYRCUS Walker.

Lyrcus origo Walker.

Lyrcus origo Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 114, ♀.— Dalla Torre, Cat. Hym., V., 1898, p. 415.

Chile: Valparaiso (C. Darwin).

Subfamily III. Miscogasterinæ.

Tribe I. *Halticopterini.*

Genus HALTICOPTERA Spinola.

Halticoptera cleodora (Walker).

Pachylarthrus cleodora Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 116, ♂.
Halticoptera cleodora Dalla Torre, Cat. Hym., V., 1898, p. 197.

Peru: Lima (C. Darwin).

Halticoptera herse (Walker).

Pachylarthrus herse Walker, Monogr. Chalc., II., 1839, p. 82, ♂.
Halticoptera herse Dalla Torre, Cat. Hym., V., 1898, p. 198.

Chile: Chiloe.

HALTICOPTERA SARIASTER (Walker).

Pachylarthrus sariaster Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 271, ♀♂.
Halticoptera sariaster Dalla Torre, Cat. Hym., V., 1898, p. 199.
Chile: Valdivia (C. Darwin).

Genus DICYLUS Walker.

DICYLUS ARDUINE Walker.

Dicylus arduine Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 115, ♀.—Dalla Torre, Cat. Hym., V. 1898, p. 200.
Peru: Lima (C. Darwin).

DICYLUS LYNASTES Walker.

Dicylus lynastes Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 271, ♀.—Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 457.—Dalla Torre, Cat. Hym., V., 1898, p. 200.
Chile: Valdivia (C. Darwin).

TRIBE II. *Miscogasterini.*

Genus LAMPROTATUS Westwood.

LAMPROTATUS ALCANDER Walker.

Lamprotatus alcander Walker, Ann. & Mag. Nat. Hist., XII., 1843, p. 30, ♂.—Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 452, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 187.
Chile.

LAMPROTATUS BISALTES Walker.

Lamprotatus bisaltes Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 272, ♂.—Spinola Gay's Hist. fis. Chile, Zool., VI., 1851, p. 455, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 187.
Chile: Valdivia (C. Darwin).

LAMPROTATUS CÆCINA Walker.

Lamprotatus cæcina Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 114, ♀.—Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 452, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 187.
Chile: Valparaiso (C. Darwin).

LAMPROTATUS DIOXIPPES (Walker).

Miscogaster dioxippes Walker, Monogr. Chalc., II., 1839, p. 67, ♀.
Lamprotatus dioxippes Walker, List Chalc. Brit. Museum, I., 1846, p. 33.—Dalla Torre, Cat. Hym., V., 1898, p. 189.
Brazil: Bahia.

Lamprotatus cleus Walker.

Miscogaster cleus Walker, Monogr. Chalc., II., 1839, p. 85, ♀.

Lamprotatus cleus Walker, List Chalc. Brit. Museum, I., 1846, p. 33.—Dalla Torre, Cat. Hym., V., 1898, p. 189.

Chile: Chiloe.

Lamprotatus hages Walker.

Miscogaster hages Walker, Monogr. Chalc., II., 1839, p. 83, ♂.

Lamprotatus hages Walker, List Chalc. Brit. Museum, I., 1846, p. 33.—Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 451, ♂.—Dalla Torre, Cat. Hym, V., 1898, p. 189.

Chile: Chiloe.

Lamprotatus nævolus Walker.

Lamprotatus? nævolus Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 185, ♂.—Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 456, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 191.

Chile: Coquimbo (C. Darwin).

Lamprotatus natta Walker.

Lamprotatus natta Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 271, ♂.—Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 455, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 191.

Chile: Valdivia (C. Darwin).

Lamprotatus numitus Walker.

Lamprotatus numitus Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 184, ♂.—Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 453, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 191.

Chile: Isle Chonos (C. Darwin).

Lamprotatus orobia Walker.

Lamprotatus orobia Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 272, ♀.—Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 454, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 191.

Chile: Valdivia (C. Darwin).

Lamprotatus tubero Walker.

Lamprotatus tubero Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 185, ♀.—Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 450, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 193.

Chile: Coquimbo (C. Darwin).

Genus SELADERMA Walker.

SELADERMA EPULO Walker.

Seladerma epulo Walker, Monogr. Chalc., II., 1839, p. 86, ♀. — Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 449, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 194.

Chile: Chiloe.

Genus MISCOGASTER Walker.

MISCOGASTER APHAREUS Walker.

Miscogaster aphareus Walker, Monogr. Chalc., II., 1839, p. 83, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 195.

Chile: Chiloe.

MISCOGASTER NICETAS Walker.

Miscogaster nicetas Walker, Monogr. Chalc., II., 1839, p. 84, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 195.

Chile: Chiloe.

MISCOGASTER TYCHE Walker.

Miscogaster tyche Walker, Monogr. Chalc., II., 1839, p. 84, ♂. — Dalla Torre, Cat. Hym., V., 1898, p. 198.

Chile: Chiloe.

SUBFAMILY IV. LELAPINÆ.

Genus LELAPS HALIDAY.

LELAPS AVICULA Haliday.

Lelaps avicula Haliday, Trans. Ent. Soc. London, III., 1843, p. 300, ♂.

Lælaps avicula Dalla Torre, Cat. Hym., V., 1898, p. 184.

Brazil.

LELAPS CALLISTO (Marshall).

Lælaps callisto Marshall, Ann. soc. ent. France, LXI., 1892, p. 73; Pl. 4, f. 3.—Dalla Torre, Cat. Hym., V., 1898, p. 184.

Venezuela.

LELAPS DECORATA Walker.

Lelaps decorata Walker, Trans. Ent. Soc. London (3), I., 1862, p. 390, ♀.

Lælaps decorata Dalla Torre, Cat. Hym., V., 1898, p. 184.

Brazil: Ega.

LELAPS PICTA Walker.

Lelaps picta Walker, Trans. Ent. Soc. London (3), I., 1862, p. 390, ♀.

Lælaps picta Dalla Torre, Cat. Hym., V., 1898, p. 184.

Brazil: Ega.

LELAPS APICALIS sp. nov.

Female.—Length 4 mm. Head, thorax and abdomen pale ferruginous, the base of the abdomen and the stylus black; scape, pedicel and antennal club pale yel-

lowish, the funicle black ; legs, including coxæ, flavo-testaceous. Wings hyaline, with a curved fuscous streak at basal third, a large fuscous spot beyond this, including the disk, connected with the basal nervure and extending to the hind margin ; there is a large hyaline spot beneath the marginal vein and the apex of the stigmal vein ; another triangular hyaline spot at the hind margin, while the apex of the wing is also hyaline. The head and thorax are opaquely punctate, without striæ ; the abdomen is conic-ovate, smooth and polished and terminates in a black, subcompressed stylus. The antennæ are subclavate, not long, the flagellum being only about twice the length of the scape, the last three joints of the funicle a little wider than long.

Brazil : Chapada, in August.

Lelaps affinis, sp. nov.

Female.—Length 4 mm. Head, thorax and abdomen, except the tip of the stylus which is black, pale ferruginous ; scape, pedicel, first three joints of funicle, the last joint of funicle, and the club, pale yellowish or whitish ; legs, including the coxæ, flavo-testaceous, the coxæ and tarsi however tinged with white. Front wings hyaline, with a fuscous band across from the base of the marginal vein and enclosing the basal part of the stigmal vein ; this is followed by a hyaline transverse band and then by another narrow transverse fuscous band ; the apex of the wing is hyaline. The head and thorax are finely opaquely sculptured ; the face above the insertion of the antennæ is finely, transversely aciculate, but smooth near the eye margin ; the axillæ are finely longitudinally aciculate. The abdomen is shaped as in *L. apicalis.*

Brazil : Santarem.

Lelaps ferruginea, sp. nov.

Female. — Length 3.6–4 mm. Head, thorax and abdomen, pale ferruginous, the extreme tip of the stylus black ; antennæ pale yellowish with the two last joints of the funicle and the club black ; the funicle, without the pedicel, is fully three times as long as the scape ; legs, including the coxæ, pale flavo-testaceous, the coxæ and the tarsi tinged with whitish, the hind tibiæ fuscous or subfuscous. Front wings mostly fuscous, the base and tips hyaline and with two wedge-shaped hyaline spots *vis-à-vis* across the disk, just beyond the stigmal vein, their points meeting. The head and thorax are sculptured as in *L. affinis* except that the axillæ are not longitudinally aciculate and the posterior half of the mesopleura is perfectly smooth and highly polished.

Brazil : Santarem. Two specimens.

LELAPS ÆNEICEPS, sp. nov.

Female. — Length 3.5–4 mm. Head æneous black, the thorax and the abdomen ferruginous, the middle lobe of the scutellum basally, a band across the middle of the abdomen and the tip of the stylus, black; face striate; antennæ pale yellowish, with the last four or five joints of the funicle black; the flagellum is long, fully three times as long as the scape, the joints long, the last joint of the funicle only a little longer than thick, but the shortest joint; legs pale yellowish, the coxæ and tarsi whitish, the middle femora sometimes dusky or subfuscous basally. The front wings are hyaline, with the apex fuscous; there is also a faint fuscous streak across from the origin of the marginal vein. The abdomen is conic-ovate, produced into a rather long stylus at apex; the stylus is compressed towards apex and about as long as the large second segment, the second segment blackish or fuscous at apex.

Brazil: Chapada and Santarem.

LELAPS HALIDAYI, sp. nov.

Female. — Length 10.5 mm. Head and thorax æneous black, with a faint purplish tinge in certain lights; face coarsely striate; pronotum transversely striate, the striæ coarser on the collar; mesonotum anteriorly delicately transversely striate, the lobes posteriorly roughly punctured; scutellum striate; metanotum rugulose, bifoveolate at base. The antennæ are long, black, the scape metallic black but more or less testaceous beneath; the flagellum is about thrice as long as the scape, subclavate, pubescent, the joints elongate. The legs are testaceous, the front and hind coxæ and trochanters, base of middle tibiæ and the tarsi basally are yellowish-white, the front tibiæ at apex and the hind tibiæ at apical two thirds are fuscous. The abdomen is rufous and terminates in a long stylus, the sheaths of the ovipositor being black. The front wings are hyaline, with a large triangular fuscous spot on the disk, a large oval fuscous spot at apex and a small fuscous spot at the origin of the marginal vein.

Brazil: Rio de Janeiro, in October.

Dedicated to the memory of A. H. Haliday, Esq., the describer of the genus, and who did so much to advance the knowledge of the parasitic Hymenoptera.

LELAPS ABDOMINALIS, sp. nov.

(Plate XXXVI, Fig. 1.)

Female.— Length 8.5 mm. Head and pronotum dark blue, the rest of the thorax black or æneous black; abdomen red, with the extreme apex black; scape and pedicel of the antennæ and the legs pale testaceous, the tips of the coxæ, sutures of trochanters, knees and tarsi basally, more or less whitish, the tips of the

middle and hind tibiæ fuscous. The front wings are very similar to those in *L. halidayi*, only the fuscous spot at the apex extends all across the wing and leaving a whitish band between it and the apex of the stigmal vein. The face, pronotum and scutellum are coarsely striate.

Brazil: P. Branca, in April.

LELAPS BIMACULATA, sp. nov.

Female.— Length 3–4 mm. Head and thorax æneous black, the thorax above more or less bronzy green, the abdomen polished black; scape, pedicel, basal two or three joints of the flagellum and most of the legs pale yellowish, the coxæ basally and the femora, especially the front and hind femora, æneous black or brown, the tips of the coxæ, base of tibiæ and the tarsi basally, whitish. The front wings are hyaline, with a fuscous spot at apex and another beneath and including the stigmal vein. The abdomen, with its long stylus, is longer than the head and thorax united, the stylus alone being about two thirds the length of the body of the abdomen. The head is shining, with the face delicately longitudinally striate; the thorax is sculptured, the base of the mesonotum, the axillæ and the apex of the scutellum being striate. The antennæ are long, the flagellum being subclavate and more than three times the length of the scape, the funicle joints all longer than thick, the basal joints the longest.

Brazil: Chapada, in April; Santarem; and P. Branca.

LELAPS STYLATA, sp. nov.

Female.— Length 5.5–6 mm. Head and thorax æneous black, the thorax above sometimes bronzed green, the abdomen polished black, ending in a long stylus, which is as long as or a little longer than the body of the abdomen; scape, base of flagellum and sometimes the tip, and most of the legs, except as noted, pale yellowish, the front and middle coxæ basally, and the front femora, brown or black, the hind femora, except basally and at tips, subfuscous, the tips of hind tibiæ dusky, the hind coxæ, trochanters, all tibiæ more or less and especially basally, and all tarsi basally, more or less white or tinged with white; the stylus is sometimes testaceous basally or with only the apex black, more rarely wholly black.

Brazil: Chapada, in April; Santarem.

Family LXVII. CLEONYMIDÆ.

Subfamily I. Chalcedectinæ.

Genus CHALCEDECTES Walker.

Chalcedectes histrionica (Westwood).

Polychroma histrionica Westwood, Thesaur. ent. Oxon., 1874, p. 141; Pl. 26, f. 6.
Polychromatium histrionicum Dalla Torre, Cat. Hym., V., 1898, p. 186.
Brazil: Santarem. Two specimens.

Chalcedectes maculicornis Walker.

Chalcedectes maculicornis Walker, Ann. & Mag. Nat. Hist. (2), X., 1853, p. 47, ♀.
Chalcodectes maculicornis Dalla Torre, Cat. Hym., V., 1898, p. 186.
Brazil: Para; Santarem. Two specimens.

Chalcedectes regalis (Westwood).

Polychroma regalis Westwood, Thesaur. ent. Oxon., 1874, p. 141; Pl. 26, f. 7.
Polychromatium regale Dalla Torre, Cat. Hym., V., 1898, p. 186.
Brazil: Amazon (Bates).

Chalcedectes sedecimdendatus (Westwood).

Polychroma sedecimdentata Westwood, Thesaur. ent. Oxon., 1874, p. 141.
Polychromatium sedecimdentatum Dalla Torre, Cat. Hym., V., 1898, p. 186.
Brazil.

Chalcedectes septemdentatus (Westwood).

Polychroma septemdentata Westwood, Thesaur. ent. Oxon., 1874, p. 142.
Polychromatium septemdentatum Dalla Torre, Cat. Hym., V., 1898, p. 186.
Brazil: Para (Bates).

Chalcedectes annulipes, sp. nov.

(Plate XXXVI., Fig. 2.)

Female. — Length about 7 mm. Metallic purplish and green, with cupreous tingings, a more decided green spot on the anterior middle of the pronotum and on the disk of the scutellum, the legs metallic greenish and æneous, the hind coxæ more bluish posteriorly, the three basal joints of the tarsi and a broad band on the hind tibiæ at base, white, the terminal joints of tarsi brown or brown black. The wings are hyaline, the veins light brown, the subcostal vein yellowish towards apex. The swollen hind femora are armed with about thirteen or fourteen minute teeth. The abdomen is conic-ovate, a little longer than the head and thorax united, depressed.

Brazil: Chapada, in January; Corumba, in May.

Subfamily II. Cleonyminæ.

Genus LYCISCA Spinola.

Lycisca apicalis Walker.

Lycisca apicalis Walker, Trans. Ent. Soc. London (3), I., 1862, p. 393, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 231.

Brazil: Ega (Bates); Santarem. Three specimens.

Lycisca hastata Walker.

Lycisca hastata Walker, Trans. Ent. Soc. London (3), I., 1862, p. 393, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 231.

Brazil: Ega (Bates).

Lycisca ignicauda Westwood.

(Plate XXXVI., Fig. 3.)

Lycisca ignicauda Westwood, Thesaur. ent. Oxon., 1874, p. 148; Pl. 27, f. 10.—Dalla Torre, Cat. Hym., V., 1898, p. 231.

Brazil: Para (Bates); Santarem; Chapada, in November; Corumba, in April. Eight specimens.

Lycisca maculipennis (Philippi).

Proglochin maculipennis Philippi, Stettin. ent. Zeitg., XXXII., 1871, p. 289; Pl. 3, f. 3, 3[a].

Lycisca maculipennis Westwood, Thesaur. ent. Oxon., 1874, p. 149.—Dalla Torre, Cat. Hym., V., 1898, p. 231.

Chile: Valdivia, near Los Ulmos.

Lycisca raptoria Spinola.

Lycisca raptoria Spinola, Rev. Zool., 1840, p. 18.—Spinola, Mag. de Zool., X., 1840, p. 18, ♀; Pl. 43.—Spinola, Mem. accad. sc. Torino (2), XIII., 1851, p. 44, ♀.—Westwood, Thesaur. ent. Oxon., 1874, p. 148.—Dalla Torre, Cat. Hym., V., 1898, p. 231.

Brazil: Cayenne.

Lycisca romandii Westwood.

Lycisca romandii Westwood, Magas. de Zool., XI., 1841, p. 84; Pl. 84.—Guérin, Iconogr. règn. anim., VII., 1845, p. 416.—Westwood, Thesaur. ent. Oxon., 1874, p. 148.—Dalla Torre, Cat. Hym., V., 1898, p. 230.

Brazil: Cayenne.

Lycisca westwoodii Guérin.

Lycisca westwoodii Guérin, Iconogr. règn. anim., VII., Ins., 1845, p. 416.—Dalla Torre, Cat. Hym., V., 1898, p. 231.

Colombia.

Genus CLEONYMUS Latreille.

CLEONYMUS COLLARIS Spinola.

Cleonymus collaris Spinola, Mém. accad. sc. Torino (2), XIII., 1853, p. 46, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 182.

Brazil: Para.

Genus TRIGONODERUS Westwood.

TRIGONODERUS BRASILIENSIS, sp. nov.

(Plate XXXVI., Fig. 4.)

Female. — Length 4 mm. Bronzed green, the face in front, the thorax at the sides and beneath, and the coxæ bluish-green; abdomen elongate, conically pointed, much longer than the head and thorax united, blue-black, with a metallic æneous tinge at base; scape, pedical, tegulæ and legs, except as noted, honey-yellow, the hind femora dusky; flagellum brown-black. Wings hyaline, the veins yellowish.

Brazil: Chapada, in April. One specimen.

Genus EPISTENIA Westwood.

EPISTENIA ÆQUALIS Walker.

Epistenia æqualis Walker, Trans. Ent. Soc. London (3), I., 1862, p. 392, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 177.

Brazil: San Paulo.

EPISTENIA ANIA Walker.

Epistenia ania Walker, List Chalc. Brit. Museum, I., 1846, p. 93, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 177.

Brazil.

EPISTENIA BASALIS Walker.

(Plate XXXV., Fig. 5.)

Epistenia basalis Walker, Trans. Ent. Soc. London (3), I., 1862, p. 397, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 177.

Brazil: Tapagos (Bates); Santarem. Two specimens.

EPISTENIA QUADRIPLAGIATA Walker.

Epistenia quadriplagiata Walker, Notes on Chalc., Pt. 5, 1872, p. 85, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 178.

Brazil.

EPISTENIA SCUTATA Walker.

Epistenia scutata Walker, Trans. Ent. Soc. London (3), I., 1862, p. 391, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 178.

Brazil.

Subfamily III. Pelecinellinæ.

Genus PELECINELLA Westwood.

Pelecinella howardii Ashmead.

(Plate XXXVI., Fig. 6.)

Pelecinella howardii Ashmead, Proc. Ent. Soc. Washington, III., 1895, p. 233, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 178.

Brazil: Chapada, in November. Two specimens.

Pelecinella phantasma Westwood.

Pelecinella phantasma Westwood, Trans. Ent. Soc. London, 1868, p. xxxv.—Westwood, Thesaur. ent. Oxon., 1874, p. 142; Pl. 26, f. 8.—Ashmead, Proc. Ent. Soc. Washington, III., 1895, p. 233, ♀.

Brazil: Amazon (Bates).

Pelecinella westwoodii Ashmead.

Pelecinella westwoodii Ashmead, Proc. Ent. Soc. Washington, III., 1895, p. 233, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 178.

Brazil: Chapada, in March; P. Branca, in April. Two specimens.

Family LXVII. ENCYRTIDÆ.

Subfamily I. Eupelminæ.

Tribe I. *Eupelmini.*

Genera OODERELLA Ashmead.

Ooderella smithii Ashmead.

(Plate XXXVII., Fig. 1.)

Ooderella smithii Ashmead, Proc. Ent. Soc. Washington, IV., 1896, p. 11, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 268.

Brazil: Chapada, in April. One specimen.

Genus BRASEMA Cameron.

Brasema fuscipennis, sp. nov.

Female.—Length 7 mm. Uniformly dark blue, closely punctate, the mesopleura and the coxæ clothed with a white pubescence. Wings fuscous, a little paler at tips. Head very broad, lenticular, without antennal furrows; eyes brown, faintly hairy; ocelli red, arranged in a triangle; mandibles small, 3-dentate at apex; legs

concolorous with the body, the sutures of the trochanters yellowish, the tibiæ subdilated towards apex, the hind tibiæ subcompressed, ending in two short spurs, the middle tibiæ ending in one strong spur, the middle tarsi dilated with joints one to four armed with two rows of black teeth beneath.

Brazil: Santarem. One specimen.

Genus IDÓLEUPELMUS Ashmead.

IDOLEUPELMUS ANNULICORNIS Ashmead.

Idoleupelmus annulicornis Ashmead, Proc. Ent. Soc. Washington, IV., 1896, p. 13, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 271.

Brazil: Santarem. West Indies: St. Vincent.

Genus MACREUPELMUS Ashmead.

MACREUPELMUS BRASILIENSIS Ashmead.

(Plate XXXVII., Fig. 2.)

Macreupelmus brasiliensis Ashmead, Proc. Ent. Soc. Washington, IV., 1896, p. 14, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 271.

Brazil: Santarem. Four specimens.

Genus ISCHNOPSIS Ashmead.

ISCHNOPSIS THORACICA sp. nov.

Female.—Length 3.5 mm. Head metallic green, finely punctate, the face with a fine, glittering white pubescence; eyes black; antennæ, thorax, legs and abdomen honey-yellow. The abdomen is longer than the head and thorax united, and tinged with fuscous towards apex, the ovipositor short, but distinct.

Brazil: Santarem. One specimen.

ISCHNOPSIS CYANEA sp. nov..

Female.—Length 3.5 mm. Uniformly dark blue, the thorax with a greenish tinge in certain lights, closely finely punctate, and clothed with short, scale-like, white hairs; the tibial spurs and the tarsi, except toward apex, yellowish-white, the basal joints always white; eyes large, converging above, brown and faintly pubescent. Wings hyaline, veins light brown.

Brazil: Santarem.

Genus EUPELMUS Dalman.

EUPELMUS AMERICANUS Spinola.

Eupelmus ? americanus Spinola, Mem. accad. sc. Torino (2), XIII., 1851, p. 47.—Dalla Torre, Cat. Hym., V., 1898, p. 273.

Brazil: Para.

EUPELMUS AMILLARUS Walker.

Eupelmus amillarus Walker, Ent. Mag., V., 1838, p. 475, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 273.

Brazil.

EUPELMUS BASICUPREUS Walker.

Eupelmus basicupreus Walker, Ann. & Mag. Nat. Hist. (2), X., 1852, p. 45, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 274.

Brazil: Para.

EUPELMUS EXCELLENS Westwood.

Eupelmus excellens Westwood, Thesaur. ent. Oxon., 1874, p. 149.—Dalla Torre, Cat. Hym., V., 1898, p. 276.

Brazil: Para (Bates).

EUPELMUS KOEBELEI, sp. nov.

Female.—Length 2.6 mm. Apterous and of a bluish-green color, the head in front gold-green, the abdomen blue-black, with an æneous tinge, cupreous at base and beneath, the ovipositor yellowish, with a black annulus at base and at tip; the ovipositor is hardly one third the length of the abdomen; the pronotum is bluish, with a tuft of long black hairs on the anterior middle above; legs æneous black, the sutures of the trochanters, tips of all tibiæ, a spot at base of middle tibiæ, and all tarsi, except the last joint, brownish-yellow or yellowish-white.

Type.—Cat. No. 7660, U. S. N. M.

Brazil: Bonito Prov., Pernambuco, February, 1883 (Mr. Albert Koebele).

EUPELMUS ACAUDUS, sp. nov.

Female.—Length 2 mm. Metallic green, the head on the vertex and the mesopleura blue-green; scape, pedicel and legs, including the coxæ, pale honey-yellow; flagellum brown-black. The wings are hyaline, with the veins yellowish. The abdomen conic-ovate, as long as the head and thorax united, æneous black, the ovipositor not prominent, the sheaths yellowish and only slightly projecting beyond the tip of the abdomen.

Brazil: Santarem. One specimen.

EUPELMUS PROXIMUS, sp. nov.

Female.—Length 1.6 mm. Æneous black, the head in front metallic green; scape æneous black, the pedicel at apex and beneath yellowish, the flagellum black; legs, except coxæ which are metallic, brownish-yellow, the front femora toward apex faintly dusky. The wings are hyaline, the veins yellowish. The abdomen is elongate, conically pointed, æneous black, longer than the head and thorax united, the ovipositor not prominent, the sheaths yellowish and only slightly projecting.

Brazil: Chapada, in April. One specimen.

EUPELMUS COMPRESSIVENTRIS, sp. nov.

Female.—Length 3 mm.; ovipositor about one third the length of the abdomen and broadly ringed with yellow. Head and thorax blue, with a faint greenish tinge in certain lights, the mesopleura decidedly æneous; abdomen compressed, æneous black; antennæ, except the club, and the legs, except the coxæ basally, brownish-yellow, the hind femora faintly dusky medially.

Brazil: Corumba, in March. One specimen.

EUPELMUS APRILIS, sp. nov.

Female.—Length 2 mm.; ovipositor short but distinct, the length of the basal joint of hind tarsi, testaceous. Head and thorax metallic green; antennæ black, the scape æneous black; legs except the femora, the hind coxæ, a spot at base of the front tibiæ outwardly, straw-yellow. The wings are hyaline, the veins yellowish. The abdomen is elongate, conically pointed, longer than the head and thorax united and æneous black.

Brazil: Chapada, in April. One specimen.

EUPELMUS CHAPADÆ, sp. nov.

Female.—Length 2.8 mm.; ovipositor projecting, not ringed with yellow, but with the tip brownish. Head, thorax and abdomen metallic green, the mesopleura with a purplish tinge; antennæ except a narrow annulus at the apex of the pedicel, wholly back; legs, except the front and hind coxæ, pale ferruginous or brownish-yellow. The wings are hyaline, the veins yellowish. The abdomen is conically pointed, longer than the head and the thorax united.

Brazil: Chapada, in April. One specimen.

EUPELMUS SANTAREMENSIS, sp. nov.

Female.—Length 3.5 mm.; ovipositor about one third the length of the abdomen, ringed with yellow. Head and thorax blue or bluish-green, the head in front and the mesonotal ridges metallic-green; scape and an annulus at the apex of the pedicel, yellow; legs, except the front and the hind coxæ and more or less of their femora which are metallic blue or blue-green, pale ferruginous or brownish-yellow.

Brazil: Santarem.

EUPELMUS PERSIMILIS, sp. nov.

Female.—Length 4 mm.; ovipositor prominent, broadly ringed with yellowish-white. This species is allied to *E. santaremensis,* but it is slightly larger, the lateral ridges of the mesonotum, the elevated basal part of the middle lobe and the scutellum are more decidedly gold-green; the disk of the mesopleura is greener; the antennæ, except the club, are wholly yellow; while the legs, except the coxæ and a

streak on the hind femora, are pale ferruginous, the apex of the hind tibiæ and their tarsi being white.

Brazil: Corumba, in May. One specimen.

EUPELMUS CORUMBÆ, sp. nov.

Female.—Length 2.5 mm.; ovipositor short, not ringed with white. Bluish-green, the anterior part of the middle mesothoracic lobe and the mesopleura posteriorly more decidedly green; antennæ, except the scape beneath, black; legs metallic brown, the coxæ blue-green, the trochanters, knees and base and tips of tibiæ, yellowish, the tibial spurs and the tarsi, except the last two joints, white or yellowish-white. Wings hyaline, the veins yellowish.

Brazil: Corumba, in May. One specimen.

EUPELMUS UNIFASCIATUS, sp. nov.

Female.—Length 3.8 mm.; ovipositor prominent, more than one third the length of the abdomen, yellowish basally, brownish towards tip but with the extreme tip yellowish. Blue, with a glittering white pubescence; prothorax and the lateral lobes of the mesonotum gold-green; antennæ black, the scape subcompressed, metallic æneous, legs æneous or bronzed, the sutures of the trochanters and the knees testaceous, the middle and hind tarsi basally whitish. Wings subfuscous, hyaline at base and with a narrow transverse band from before the origin of the stigmal vein.

Brazil: Chapada, in August. One specimen.

EUPELMUS SIMILLIMUS, sp. nov.

Female.—Length 2 mm.; ovipositor prominent, with a broad yellowish band. Metallic green; head above smooth, æneous black; palpi white; front wings with the apical two thirds fuscous, the fuscous part with two oblique white spots, *vis-à-vis*, one extending from the front margin just before the stigmal vein, the other just opposite it on the hind margin, as in the West Indian *E. albomaculatus*; legs metallic brownish, the apices of the coxæ, the trochanters, the front and middle femora beneath, and the rest of the legs, except the base of the front and middle tibiæ outwardly, white or whitish.

Brazil: Chapada, in April. One specimen.

EUPELMUS MAGNICLAVATUS, sp. nov.

Female.—Length 4.5 mm.; ovipositor short, only about two thirds the length the basal joint of hind tarsi, and yellowish-white. Blue, closely, finely punctate, the mesonotal depression greenish; wings hyaline, with a fuscous cloud extending from the tip of the stigmal vein into the discoidal region, then curving backwards

and connected with a faint cloud that extends from the base of the marginal vein; antennæ æneous black, ending in a large stout club which is nearly as long as the scape, the last four joints of the funicle being much wider than long; legs æneous black, the trochanters, or at least along the sutures, yellowish.

Brazil: Santarem. One specimen.

Genus PHLEBOPENES Perty.

Phlebopenes basilica (Marshall).

Prionopelma basilica Marshall, Ann. soc. ent. France, XLI., 1892, p. 71; Pl. 4, f. 2.
Phlebopenes basilica Dalla Torre, Cat. Hym., V., 1898, p. 279.

Venezuela: San Esteban.

Phlebopenes consors (Walker).

Prionopelma consors Walker, Trans. Ent. Soc. London (3), I., 1862, p. 395, ♀.
Phlebopenes consors Dalla Torre, Cat. Hym., V., 1898, p. 279.

Colombia: New Grenada.

Phlebopenes longicaudata (Westwood).

Prionopelma longicaudata Westwood, Thesaur. ent. Oxon., 1874, p. 145, ♀; Pl. 27, f. 4.
Phlebopenes longicaudata Dalla Torre, Cat. Hym., V., 1898, p. 279.

Brazil: Para (Bates).

Phlebopenes longicollis Westwood.

Prionopelma longicollis Westwood, Thesaur. ent. Oxon., 1874, p. 145; T. 27, f. 1.
Phlebopenes longicollis Dalla Torre, Cat. Hym., V., 1898, p. 279.

Brazil: Para (Bates); Chapada. One specimen.

Phlebopenes longifica (Walker).

Prionopelma longifica Walker, Notes on Chalc., Pt. 5, 1872, p. 84, ♀.
Phlebopenes longifica Dalla Torre, Cat. Hym., V., 1898, p. 297.

Brazil: Para (Bates); Santarem. One specimen.

Phlebopenes purpurea (Walker).

Prionopelma purpurea Walker, Trans. Ent. Soc. London (3), I., 1862, p. 395, ♀.
Phlebopenes purpurea Dalla Torre, Cat. Hym., V., 1898, p. 279.

Brazil: Tapayos and Ega (Bates).

Phlebopenes splendens (Walker).

Prionopelma splendens Walker, Trans. Ent. Soc. London (3), I., 1862, p. 396, ♂.
Phlebopenes splendens Dalla Torre, Cat. Hym., V., 1898, p. 279.

Brazil: Villa Nova (Bates).

PHLEBOPENES SPLENDIDUS Perty.

Phlebopenes splendidus Perty, Delectus. anim. Artic. Brasil., 1833, p. 132; T. 26, f. 11.— Dalla Torre, Cat. Hym., V., 1898, p. 279.

Brazil.

PHLEBOPENES VIRIDIS (Westwood).

Prionopelma viridis Westwood, Proc. Zool. Soc. London, III., 1835, p. 51.— Westwood, Thesaur. ent. Oxon., 1874, p. 144.

Phlebopenes viridis Dalla Torre, Cat. Hym., V., 1898, p. 279.

Brazil.

PHLEBOPENES ABDOMINALIS, sp. nov.

Female. — Length to tip of abdomen 8.5–9 mm.; ovipositor about 25 or 26 mm. long. Head and thorax blue, with faint greenish tingings in certain lights; antennæ black, the scape subcompressed, æneous black; legs, except the coxæ, and abdomen pale ferruginous, the long ovipositor being black. Wings hyaline, the veins brownish.

Brazil: Rio de Janeiro, in November. One specimen.

PHLEBOPENES PERTYI, sp. nov.

(Plate XXXVII., Fig. 3.)

Female. — Length to tip of abdomen about 9 mm.; ovipositor about 27 mm. long. Head and thorax blue, the ridges of the mesonotum tinged with æneous; antennæ black; the prosternum, the legs, including all coxæ, and the abdomen pale ferruginous, the abdomen of a darker red.

Brazil: Santarem. One specimen.

This species resembles *P. abdominalis*, but is easily separated by the color of the coxæ.

ENCYRTASPIS Ashmead, gen. nov.

This genus is at once recognized by the tuft of long black hairs on the scutellum as in the genus *Encyrtus* Latreille (= *Comys* Förster), by the shape of the head, the scrobes being very short, hardly impressed, and by the abdomen, which has the hypopygium prominent and ends in a long ovipositor.

ENCYRTASPIS BRASILIENSIS, sp. nov.

(Plate XXXVII., Fig. 4.)

Female.— Length about 4 mm.; ovipositor longer than the body, with a broad white band before the apex. Blue with greenish reflections, the head in front æneous, the abdomen æneous black, with a testaceous band near the base, the scutellum red with a tuft of long black hairs. The antennæ, except the last two or

three joints of the funicle and the club which are black or dark fuscous, are yellowish; the legs are brownish or fuscous, the trochanters yellowish, the hind tibiæ compressed, the hind margin of same being white; joints one to three of the middle tarsi and joints two and three and apex of joint one of the hind tarsi white. The front wings, except the basal one third and the apical one fourth, fuscous, the base and apex hyaline.

Type.—Cat. No. 7661, U. S. N. M.

Brazil: Pernambuco. (Mr. Albert Koebele.)

Genus ANASTATUS Motschulsky.

TABLE OF SPECIES.

1. Thorax and abdomen mostly metallic blue or green........ 2
   Thorax and abdomen honey-yellow, or for the greater part.
   Thorax honey-yellow; head gold-green, closely punctate; front wings subfuscous, the basal third a transverse band before the apex and two triangular spots, *vis-à-vis*, beneath the marginal vein, hyaline or white........ *A. auriceps*, sp. nov.
   Thorax yellowish but with the middle mesothoracic lobe and the metanotum bluish-green; head metallic green, closely punctate; front wings fuscous, with a band at base, and another across from the base of the stigmal vein, hyaline........ *A. coreophagus*, sp. nov.
2. Metallic blue-green or bluish........ 3
   Metallic green, the disk of the mesonotum purplish, the mesopleura posteriorly, the ridge in front of the tegulæ, and a band at base of the abdomen honey-yellow; front wings subfuscous, the basal third and a transverse band across from the marginal vein, hyaline or white........ *A. pleuralis*, sp. nov.
3. Collar and base of abdomen *not* yellow........ 4
   Collar and base of abdomen yellow or whitish.
   Head gold-green; front wings fuscous with the basal third, and a band across from before the stigmal vein, hyaline........ *A. basalis*, sp. nov.
4. Abdomen finely punctate or shagreened, with a yellowish band at base; front wings fuscous, paler at tips, the basal third hyaline, the disk with a narrow transverse band from the apex of the marginal vein........ *A. punctiventris*, sp. nov.
   Abdomen smooth, æneous black; front wings fuscous, the basal third, and a transverse band across the disk before the origin of the stigmal vein, hyaline........ *A. unifasciatus*, sp. nov.

ANASTATUS AURICEPS, sp. nov.

Female.—Length 2.5–3 mm. Head metallic gold-green, punctate, the thorax, abdomen, legs and antennæ, except the club, honey-yellow, the palpi white.

The thorax and abdomen are smooth, impunctate; the metathorax has a metallic band at base, enclosing the spiracles and on the dorsum of the abdomen laterally are a few fuscous spots. The antennæ, except the club, are yellow, the flagellum subclavate, twice the length of the scape. The front wings are subfuscous, with the basal third, a transverse band before apex, and two triangular spots *vis-à-vis* beneath the marginal vein, hyaline or whitish.

Brazil: Corumba, lowlands in March; Chapada, in April. The specimen from Chapada is the smaller, but agrees well with the other, except the flagellum is fuscous from the third joint and there is a bluish-green spot on the disk of the mesonotum.

ANASTATUS COREOPHAGUS, sp. nov.

Female.— Length 2.4 mm. Head gold-green, closely punctate; thorax, except the middle mesothoracic lobe and the metanotum, which are bluish-green, and the abdomen yellowish or honey-yellow; antennæ, except the scape, pedicel and first two or three joints of the funicle, which are yellowish or yellowish-white, black or brown-black; legs yellowish, the tarsi, except the last joint, paler. Front wings, except at base and a transverse band across from the base of the stigmal vein, fuscous, at base and the band hyaline or whitish.

Type.—Cat. No. 7664, U. S. N. M.

Brazil: Pernambuco. Bred June 12, 1883, by Mr. Albert Koebele, from the eggs on an unknown coreid.

ANASTATUS PLEURALIS, sp. nov.

Female.— Length 2.6 mm. Metallic green, the disk of the mesonotum and the mesopleura anteriorly purplish or bluish-green; the scape, the ridge in front of the tegulæ, the tegulæ, the mesopleura posteriorly, a broad band at base of abdomen, and the legs, except as noted, honey-yellow; the front femora above faintly, a narrow stripe on the middle femora above, the hind femora and tibiæ above, and the basal joint of hind tarsi, are brown or fuscous; the middle coxæ basally and the hind coxæ are metallic. Front wings subfuscous, the basal third and a band across the disk from the middle of the marginal vein, hyaline or whitish.

Brazil: Chapada, in April. One specimen.

ANASTATUS BASALIS, sp. nov.

Female.—Length 4.2 mm. Blue-green; the prothorax, scape and legs, yellowish or pale ferruginous, the middle tibiæ and the hind femora and tibiæ more or less brown or fuscous, the tarsi whitish; abdomen æneous black, with a broad whitish band at base. Front wings with the apical two thirds, except a narrow whitish band across from the marginal vein, fuscous, the basal third hyaline.

Brazil: Chapada, in August. One specimen.

ANASTATUS PUNCTIVENTRIS, sp. nov.

Female.—Length 4 mm. Metallic blue-green, more decidedly green on the disk of the mesonotum anteriorly and on the vertex; the whole body, including the abdomen, is closely punctate. The scape, pedicel, first three or four joints of the flagellum, and a band at the base of the abdomen, are honey-yellow; legs brownish

or fuscous, the front trochanters, a spot on the knees, a stripe on the middle tibiæ *beneath* and the hind femora beneath, yellowish. The front wings, except the basal third and a narrow transverse band on the disk from near the apex of the marginal vein, are fuscous, the basal third and the narrow transverse band being hyaline or whitish.

Type. — Cat. No. 7662, U. S. N. M.

Brazil: Chapada; Bahia (Mr. A. Koebele).

This is the only species known in this genus with a punctate abdomen. The specimens from Bahia were bred in March, 1883, by Mr. Albert Koebele, from the eggs of an unknown locustid.

Anastatus unifasciatus, sp. nov.

Female.—Length about 5 mm. Dark blue-green, the vertex and disk of the mesonotum more decidedly green; scape yellow, the flagellum, including the pedicel, brown-black, the club with a whitish spot on the oblique truncature; legs dark brown or fuscous, the front and middle tarsi and joints two to four of hind tarsi *beneath*, yellowish-white. Wings much as in *A. basalis*.

Brazil: Rio de Janeiro.

Tribe II. *Tanaostigmini.*

Trichencyrtus Ashmead, gen. nov.

This genus is allied to *Tanaostigmodes* Ashmead, and resembles it in shape, but the body is not bare, as in that genus, but clothed with short, scale-like, white hairs. It is also easily separated by the difference in the antennæ, the scape being subcompressed, the funicle joints one to three being wider than long. In *Tanaostigmodes* the funicle joints are cylindrical and longer than wide.

Trichencyrtus robustus, sp. nov.

(Plate XXXVII., Fig. 5.)

Female.—Length 2 mm. Robust, æneous black, with metallic bluish reflections in certain lights, the whole body clothed with short, scale-like white hairs, the head with a white band across the lower part of the face and extending on to the cheeks back of the eyes; there is also another slender white line above this, on each side; extending from the insertion of each antenna to the eye margin; the very short pronotum has a triangular white spot on each side; the front tarsi, or at least more or less beneath, and the short sheaths of the ovipositor, are testaceous. The scape of the antennæ is flat, dilated, æneous black, the flagellum dull black, pubescent, the basal joints wider than long. The wings are hyaline, the costal cell broad, the

veins light brown, the stigmal vein long, ending in a small knob, the postmarginal much shorter than the stigmal.

Brazil: Chapada, in April. One specimen

Subfamily II. Encyrtinæ.

Tribe III. *Mirini.*

Genus PARENCYRTUS Ashmead.

Parencyrtus brasiliensis, sp. nov.

(Plate XXXVII., Fig. 6.)

Parencyrtus brasiliensis Ashmead, Proc. U. S. Nat. Museum, XXII., 1900, p. 368, ♀.

Brazil: Chapada.

Genus ÆNASIUS Walker.

Ænasius chapadæ Ashmead.

(Plate XXXVIII., Fig. 1.)

Ænasius chapadæ Ashmead, Proc. U. S. Nat. Museum, XXII., 1900, p. 371, ♀.

Brazil: Chapada.

Genus BOTHRIOTHORAX Ratzeburg.

Bothriothorax brasiliensis, sp. nov.

Male.— Length 1.8 mm. Æneous black, the head and thorax with close, thimble-like punctures, sparser on the scutellum; the antennæ are brownish-yellow the first four joints of the flagellum slightly emarginate at apex, with long hairs; the legs are æneous black, the front femora toward apex, the apex of the middle femora, front and middle tibiæ and tarsi, and the hind tarsi, yellowish. Wings hyaline, the veins light brownish, the postmarginal vein only slightly developed. The abdomen in outline is triangular; shorter than the thorax, depressed and æneous.

Brazil: Chapada, in September. One specimen.

Genus HEMENCYRTUS Ashmead.

Hemencyrtus herbertii Ashmead.

(Plate XXXVIII., Fig. 2.)

Hemencyrtus herbertii Ashmead, Proc. U. S. Nat. Museum, XXII., 1900, p. 375, ♀.

Brazil: Chapada, in August and November.

Genus HEXACLADIA Ashmead.

Hexacladia smithii Ashmead.

Hexacladia smithii Ashmead, Ins. Life, III., 1891, p. 456, ♀♂. — Dalla Torre, Cat. Hym., V., 1898, p. 230. — Ashmead, Proc. U. S. Nat. Museum, XXII., 1900, p. 377.

Brazil: Chapada, in April.

Genus APHIDENCYRTUS Ashmead.

APHIDENCYRTUS EPYTUS (Walker).

Encyrtus epytus Walker, Monogr. Chalcid., II., 1839, p. 69, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 258.

Brazil: Bahia.

APHIDENCYRTUS BRASILIENSIS, sp. nov.

Male. — Length 0.8 mm. Æneous black, nearly smooth, the abdomen triangular with a metallic luster; antennæ brownish-yellow, the joints of the funicle oval, with long hairs; legs, except the coxæ and the femora, honey yellow, the coxæ black, the femora brown. Wings hyaline, the veins brown, the stigmal vein about twice as long as the marginal.

Brazil: Chapada, in April. One specimen.

Genus COCCIDENCYRTUS Ashmead.

(?) COCCIDENCYRTUS VITIS Guérin.

Encyrtus vitis Guérin, Iconogr. règne anim., VII., Ins., 1845, p. 416, ♂; T. 67, f. 14.—Dalla Torre, Cat. Hym., V., 1898, p. 265.

Brazil.

SUBFAMILY III. SIGNIPHORINÆ.

Genus SIGNIPHORA Ashmead.

SIGNIPHORA NOACKI Ashmead.

Signiphora noacki Ashmead, Proc. U. S. Nat. Museum, XXII., 1900, p. 410, ♀.

Brazil: San Paulo.

Type.—Cat. No. 4793, U. S. N. M.

SIGNIPHORA RHIZOCOCCI Ashmead.

Signiphora rhizococci Ashmead, Proc. U. S. Nat. Museum, XXII., 1900, p. 411, ♀.

Brazil: Minas Geras.

Type.—Cat. No. 4858, U. S. N. M.

FAMILY LXIX. PTEROMALIDÆ.

SUBFAMILY I. PTEROMALINÆ.

TRIBE I. *Metaponini.*

Genus METOPON Walker.

METOPON BRASILIENSE, sp. nov.

Female.—Length 2 mm. Metallic bronze-green, the head and thorax closely punctate, the abdomen with a brassy tinge, except the flagellum, the antennæ, and

legs, except the coxæ, honey yellow, the flagellum strongly clavate, pale brown, the joints after the second wider than long, the last funicle joint being more than three times as wide as long. The metathorax is almost smooth with a delicate median carina which is forked on the produced neck; no transverse fold on the metanotum. Wings hyaline, the veins yellowish. Abdomen ovate, not longer than the thorax, subcompressed beneath towards apex.

Male.—Length 2.5 mm. Agrees with female in color but easily recognized by the antennæ, the flagellum being long, filiform, the joints of the funicle being briefly pedicellate, with moderately long hairs.

Brazil: Corumba, in May; Santarem. One male and three female specimens.

Metopon magniclavatum, sp. nov.

Female.—Length 3 mm. Bronzed black, with a purplish tinge, the head and thorax closely punctate, the abdomen conically pointed, longer than the head and thorax united, æneous black; the scape, pedicel and legs, except coxæ, honey yellow, the flagellum black, the club greatly enlarged and as long as the pedicel and funicle joints united.

Brazil: Santarem. One specimen.

Quite different from all other species known by the greatly enlarged antennal, club and by the conically produced abdomen.

ACANTHOMETOPON Ashmead, gen. nov.

Allied to *Metopon* Walker, but easily separated by the spined scutellum and by the flagellum having only *two* ring-joints.

Acanthometopon clavicorne, sp. nov.

(Plate XXXVIII., Fig. 3.)

Female.—Length 3.8 mm. Bronzed green, closely punctate, the first six joints of the antennæ and the legs honey yellow, the rest of the antennæ black or brown-black. Abdomen compressed, the ventral valve prominent; *above* it has a brassy tinge, *beneath* towards apex and the ventral valve yellow.

Brazil: Corumba, in May. One specimen.

Tribe III. *Eutelini.*

Genus PLAYTERMA Walker.

Playterma nephele Walker.

Platyterma nephele Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 186, ♂.

Chile: Coquimbo.

Tribe IV. *Pteromalini.*

Genus PAPHAGUS Walker.

Paphagus sidero Walker.

Paphagus sidero Walker, Ann. & Mag. Nat. Hist., XII., 1843, p. 48, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 213.

West Indies: St. Vincent.

Genus PTEROMALUS Swederus.

Very few of the hundreds of species described by Francis Walker in this genus belong to it. The types must be studied before his species can be placed in their proper genera.

Pteromalus archia Walker.

Pteromalus archia Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 116, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 111.

Peru: Lima.

Pteromalus calenus Walker.

Pteromalus calenus Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 31, ♂.—Spinola, Gay's Hist. fis. Chile, Zool., VI., 1851, p. 445, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 115.

Chile: Conception.

Pteromalus cleophanes Walker.

Pteromalus cleophanes Walker, Monogr. Chalc., II., 1839, p. 68, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 117.

Brazil: Bahia.

Pteromalus cosis Walker.

Pteromalus cosis Walker, Monogr. Chalc., II., 1839, p. 68, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 119.

Brazil: Bahia.

Pteromalus driopides Walker.

Pteromalus driopides Walker, Monogr. Chalc., II., 1839, p. 68, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 122.

Brazil: Bahia.

Pteromalus eurypon Walker.

Pteromalus eurypon Walker, Ann. & Mag. Nat. Hist., XIX., 1847, p. 398, ♀.—Dalla Torre, Cat. Hym., V., p. 124.

Pteromalus gryneus Walker.

Pteromalus gryneus Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 115, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 442, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 127.

Chile: Valparaiso.

PTEROMALUS MEGAREUS Walker.

Pteromalus megareus Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 272, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 447, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 134.

Chile: Valdivia.

PTEROMALUS MYDON Walker.

Pteromalus mydon Walker, Monogr. Chalc., II., 1839, p. 87, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 439, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 136.

Chile: Chiloe.

PTEROMALUS ŒNÖE Walker.

Pteromalus œnöe Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 187, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 444, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 138.

Chile: Coquimbo.

PTEROMALUS OXYNTHES Walker.

Pteromalus? oxynthes Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 184, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 446, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 139.

Chile: Isle of Chonos.

PTEROMALUS PROTHOUS Walker.

Pteromalus prothous Walker, Monogr. Chalc., II., 1839, p. 87, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 440, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 142.

Chile: Chiloe.

PTEROMALUS RHŒBUS Walker.

Pteromalus rhœbus Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 187, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 442, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 146.

Chile: Coquimbo.

PTEROMALUS SESTIUS Walker.

Pteromalus sestius Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 186, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 443, ♀.—Dalla Torre, Cat Hym., V., 1898, p. 147.

Chile: Coquimbo.

PTEROMALUS TOXENUS Walker.

Pteromalus toxenus Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 186, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 447, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 151.

Chile: Coquimbo.

PTEROMALUS TRAULUS Walker.

Pteromalus traulus Walker, Monogr. Chalc., II., 1839, p. 88, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 440, ♀. —Dalla Torre, Cat. Hym., V., 1898, p. 151.

Chile: Chiloe.

PTEROMALUS VITULA Walker.

Pteromalus vitula Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 187, ♂.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 444, ♂. —Dalla Torre, Cat. Hym., V., 1898, p. 153.

Chile: Coquimbo.

PTEROMALUS VULSO Walker.

Pteromalus vulso Walker, Monogr. Chalc., II., 1839, p. 89, ♂.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 448, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 154.

Chile: Chiloe.

SUBFAMILY IV. SPHEGIGASTERINÆ.

TRIBE I. *Asaphini.*

Genus ASAPHES Walker.

ASAPHES VULGARIS Walker.

Decatoma metallica Spinola, Ann. mus. hist. nat., XVII., 1811, p. 151 (s. descrip.).

Eurytoma ænea Nees, Hym. Ichn. affin. Monogr., II., 1834, p. 42, ♀.—Reinhard, Stettin. ent. Zeitg., XX., 1859, p. 192.

Colax aphidii Curtis, Journ. Agric. Soc., III., 1842.

Pteromalus petiolatus Zetterstedt, Insect. Lappon., I., 1838, p. 432, ♀.

Chalcis vulgaris Blanchard, Cuvier: Règne. anim., Ed. 3ª, Ins., II., 1849; T. 114, f. 4.

Chrysolampus suspensus Nees, Hym. Ichn. affin. Monogr., II., 1834, p. 127.—Reinhard, Stettin. ent. Zeitg., XX., 1859, p. 192, ♀.

Chrysolampus altiventris Nees, Hym. Ichn. affin. Monogr., II., 1834, p. 127.

Chrysolampus æneus Ratzeburg, Ichn. d. Forstius, II., 1848, p. 185, ♀.—Ratzeburg, *opus cit.*, III., 1852, p. 228.

Isocratus vulgaris Förster, Hym. Stud., II., 1856, p. 58.—Thomson, Hym. Skand., IV., 1876, p. 208, ♀♂.

Asaphes vulgaris Walker, Ent. Mag., II., 1834, p. 152, ♀♂.—Blanchard, Hist. nat. Ins., III., 1840, p. 265.—Westwood, Intro. Mod. Class. Ins., II., 1840; Synop., p. 67.—Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 114, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 462.—Ratzeburg, Ichn. d. Forstius, III., 1852, p. 229.—Reinhard, Berl. ent. Zeitschr., I., 1857, p. 76.—Reinhard, Stettin. ent. Zeitg., XX., 1859, p. 194.—Dalla Torre, Cat. Hym., V., 1898, p. 205.

Chile. This species is now distributed into all parts of the world. It is parasitic on various Aphids and is also occasionally bred from Coccids.

Tribe III. *Sphegigasterini.*

Genus ACROCLISIS Förster.

Acroclisis brasiliensis, sp. nov.

Male.—Length 2.5 mm. Bluish-green, closely punctate; scape, pedicel and legs, except coxæ, honey yellow, the femora more or less brownish toward base, the tips of the femora, the tibiæ and tarsi more of a yellowish-white; flagellum filiform, brown, pubescent, the funicle joints more than twice longer than thick; metanotum rugulose, with a median carina; abdomen oblong, the petiole rugulose, opaque, with a delicate carina above, the body of abdomen æneous black, smooth and shiny. Wings hyaline, the veins brownish-yellow.

Brazil: Chapada, in January. One specimen.

Subfamily V. Spalangiinæ.

Genus SPALANGIA Latreille.

Spalangia brasiliensis, sp. nov.

Female. — Length 3.1 mm. Æneous black, the tip of hind tibiæ testaceous, the tarsi, except last joint, yellowish-white; eyes pale, hairy. The oblong head is shining but in front with sparse thimble-like punctures and a median grooved line, the cheeks being long and closely opaquely punctured; the pronotum is closely umbilicately punctate, the lobes of the mesonotum are smooth, but posteriorly in front of the scutellum is a median carina formed by two longitudinal rows of coarse punctures; there are also punctures on each side of these rows and coarse punctures in the parapsidal furrows posteriorly; the axillar sutures are coarsely punctured; the scutellum proper is smooth, impunctate, except a transverse row of coarse elongate punctures posteriorly; the metathorax is rugose from coarse pits, while the mesopleura has a large deep median sulcus and a depression filled with elevated lines along the anterior margin. Wings hyaline, faintly dusky, with the veins dark brown.

Brazil: Santarem. One specimen.

Family LXX. ELASMIDÆ.

Genus ELASMUS Westwood.

Elasmus brasiliensis, sp. nov.

Female. — Length 2 mm. Blue black, with a yellow line between the scutellum and the postscutellum; thorax above delicately reticulate, finely pubescent, the

scutellum smooth, the head in front, except a few minute punctures, smooth and shining; the scape of the antennæ, the coxæ apically, the trochanters, front and middle femora, apex of hind femora, and the tibiæ and tarsi, yellowish-white, the hind tarsi fuscous at apex; the hind femora, except at apex, are bluish; the hairs on the hind tibiæ are arranged so as to form nine areas; flagellum light brown, the club darker. The abdomen is conically produced, compressed at sides, blue black except towards base beneath, where it is testaceous. Wings hyaline, the tegulæ and the subcostal vein pale yellowish, the rest of the veins brown.

Brazil: Corumba, in May. One specimen.

ELASMUS PERAFFINIS, sp. nov.

Male. — Length 1.8 mm. Blue black with the apex of the scutellum yellow; antennæ, including the branches, brown, the scape yellowish; mandibles and palpi pale; legs yellowish-white, the base of middle and hind coxæ, and a very broad band on their femora, black; the hairs on the hind tibiæ are so arranged as to form six or seven areas. Wings hyaline, the veins light brown, the tegulæ yellowish-white.

Brazil: Exact locality not given. One specimen.

ELASMUS CHAPADÆ, sp. nov.

Female. — Length 2 mm. Blue black, the apex of the scutellum yellow, the basal two segments of the abdomen red; the face is rather closely and distinctly punctate, the thorax reticulately sculptured, the scutellum smooth, shining; antennæ brown black, the scape yellowish; legs blue black except as follows: The front legs, except the coxæ basally, the sutures between the trochanters and femora of middle and hind legs, and the tibiæ and tarsi, are pale yellowish-white, the hind tarsi appear fuscous from the pubescence; the hairs on the hind tibiæ are arranged in two longitudinal rows, the inne row, however, being intersected by a short, cross hair line, forming two long areas. Wings hyaline, the veins brown.

Brazil: Chapada. One specimen.

FAMILY LXXI. EULOPHIDÆ.

SUBFAMILY I. ENTEDONINÆ.

TRIBE I. *Tetracampini.*

No species belonging to this tribe are yet known from South America.

Tribe II. *Omphalini.*

Genus OMPHALE Haliday.

Omphale brasiliensis, sp. nov.

Female.—Length 2 mm. Blue, the thorax with an æneous tinge; a dot on the front and middle knees, the extreme apex of all tibiæ and the tarsi, except the last joint, pale yellowish-white; mandibles pale; antennæ brown black, pubescent, the scape yellowish. Wings hyaline, bare or nearly, the veins pale, the postmarginal vein hardly developed, shorter than the very short stigmal vein. The abdomen is conically pointed, subcompressed beneath at base, and a little longer than the head and thorax united.

Brazil: Chapada, in April; Corumba, in May.

This species is allied to *O. nigrocyanea* Ashm. described from Grenada, W. I.

Genus CLOSTEROCERUS Westwood.

Closterocerus cercius Walker.

Closterocerus cercius Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 31, ♀.

Entedon cercius Walker, List. Chalc. Brit. Museum, I., 1846, p. 62.— Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 435, ♀.— Dalla Torre, Cat. Hym., V., 1898, p. 34.

Chile: Conception.

Closterocerus pelor Walker.

Closterocerus pelor Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 185, ♂.

Entedon pelor Walker, List. Chalc. Brit. Museum, I., 1846, p. 62.— Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 436, ♂.— Dalla Torre, Cat. Hym., V., 1898, p. 42.

Chile: Isle of Chonos.

Closterocerus xenodice Walker.

Closterocerus xenodice Walker, Ann. & Mag. Nat. Hist., X., 1843, p. 273, ♀♂.

Entedon xenodice Walker, List. Chalc. Brit. Museum, I., 1846, p. 62.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 436, ♀♂.— Dalla Torre, Cat. Hym., V., 1898, p. 45.

Chile: Valdivia.

Tribe III. *Entedonini.*

UROENTEDON Ashmead, gen. nov.

This genus is based upon one of the most striking yet discovered in the subfamily Entedoninæ. It is easily recognized by the long, compressed abdomen which terminates in a long ovipositor, and has the hypopygium prominent, acutely plow-

share-shaped; by the very long, ten-jointed antennæ, with *two* ring-joints, the funicle joints being globosely swollen towards base, with whorls of long hairs somewhat as in the males in the genera *Hoplocrepis* and *Lophocomus;* and by the wings, which are fringed, the marginal vein being very long, the stigmal vein short, while the post-marginal vein is long. The male is unknown.

UROENTEDON VERTICELLATUS, sp. nov.

(Plate XXXVIII., Fig. 4.)

Female. — Length 3 mm.; ovipositor as long as the abdomen. Highly polished, impunctate, the head, the prothorax beneath and the legs, honey yellow, the face with a greenish metallic luster; antennæ black, except the long slender scape which is yellowish at its basal half; thorax bottle blue, the axillæ faintly testaceous towards the sutures anteriorly at the sides, the scutellum and the mesopleura æneous black; abdomen black, the tip æneous, the extreme base bluish. Wings hyaline, fringed, the veins yellowish.

Brazil: Chapada, in September. One specimen.

Genus HOPLOCREPIS Ashmead.

HOPLOCREPIS BIFASCIATA, sp. nov.

(Plate XXXVIII., Fig. 5.)

Male. — Length 1.7 mm. Æneous black, the occiput, the metathorax, the petiole of abdomen and the legs mostly testaceous, the trochanters, the extreme base of the femora and the tarsi pale yellowish, the femora and tibiæ brown, the hind tibiæ, except at base and tips, black; the lateral lobes of the mesonotum are brownish; while the body of the abdomen is small, spatulate, black.

The ten-jointed antennæ are black with the scape and pedicel yellowish; the joints of the funicle are long, nodose-pedicillate, with whorls of long hairs, the first, second and third joints with a short branch above. Wings hyaline, the front wings with two transverse fuscous bands, the first band very narrow, situated a little before the basal third, the other broad, extending across the wing from the apical middle of the marginal vein and enclosing the stigmal vein.

Brazil: Chapada. One specimen.

Differs from all other males in this genus by having short branches on funicle joints one, two and three.

HOPLOCREPIS BRASILIENSIS, sp. nov.

Female. — Length 1.6 mm. Brownish-yellow with the collar anteriorly, the mesopleura, the metanotum, the petiole and the body of abdomen above, fuscous or brownish-black. The antennæ are black with the scape yellowish; legs flavo-tes-

taceous, the hind femora medially and the hind tarsi fuscous. Wings banded as in *H. bifasciata.*

Brazil: Santarem. One specimen.

EULOPHOPTERYX Ashmead, gen. nov.

This genus comes nearest to *Lophocomus* Haliday, agreeing with it in all characters except the antennæ. The antennæ are ten-jointed, as in *Lophocomus*, but the joints of the funicle are longer than thick, cylindrical, loosely joined, not pedicellate nor compressed, with the club black or brown black, not white. In *Lophocomus* the funicle joints are distinctly although briefly pedicellate, compressed, two or three wider than long, while the club is white or yellowish-white.

Eulophopteryx chapadæ, sp. nov.

(Plate XXXVIII., Fig. 6.)

Female.—Length 1.5 mm; robust, æneous black, impunctate, except the pronotum, which is distinctly punctured; the scape, the pedicel and the legs, except as hereafter noted, are honey yellow; flagellum brown black, the front and middle femora and the base of their tarsi are metallic brown. The front wings are hyaline, with a subfuscous cloud on the disk, the veins yellowish. The abdomen is broadly oval, petiolate, not longer than the thorax, above depressed, beneath subconvex.

Brazil: Chapada, in August. One specimen.

Genus LOPHOCOMUS Haliday.

Lophocomus anaitis (Walker).

Cirrospilus anaitis Walker, Monogr. Chalc., II., 1839, p. 91, ♀.

Lophocomus anaitis Haliday, Trans. Ent. Soc. London, III., 1843, p. 297.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 432, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 70.

Bellerus anaitis Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 32, ♂.—Spinola Gay: Hist. de Chile, Zool., VI., 1851, p. 429, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 26.

Chile: Conception; Isle of Chiloe.

Lophocomus cyaneus, sp. nov.

Female.—Length 1.6 mm. Dark blue, with æneous reflections, the middle lobe of the mesonotum and the inner margins of the lateral lobes, æneous; antennæ, except the club, which is yellowish-white, black: legs honey yellow, with the hind tibiæ

fuscous, the hind coxæ and trochanters somewhat whitish; abdomen beneath rufopiceous. Wings subhyaline with a large subfuscous discoidal cloud.

Brazil: Santarem. One specimen.

Genus HORISMENUS Walker.

HORISMENUS CLEODORA Walker.

Horismenus cleodora Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 31, ♀.

Entedon cleodora Walker, List Chalc. Brit. Museum, I., 1846, p. 66.—Dalla Torre, Cat. Hym., V., 1898, p. 35.

Peru: Lima.

TABLE OF NEW SPECIES.

1. Species mostly æneous black or blue 2

   Species mostly metallic green or at least above.

   Prothorax at the sides, the mesopleura and the coxæ blue, rest of legs and the scape pale yellowish; metanotum long with two opaque sulci .... *H. bisulcus.*

2. Species mostly blue 3

   Species mostly æneous black.

   Metanotum brassy; scape, pronotum anteriorly, pleuræ and legs, except as noted, dark blue; tips of femora, the tibiæ and tarsi, except last joint, yellowish-white .... *H. brasiliensis.*

   Metanotum not brassy; head in front; the axillæ and a spot on upper margin of the mesopleura metallic greenish; scape and legs, except coxæ, honey yellow, a spot on knees, tips of tibiæ and the tarsi yellowish-white; abdomen conically pointed, a little longer than the head and thorax united .... *H. corumbæ.*

3. Scape and legs, except coxæ and parts hereafter noted, honey yellow, the femora dusky basally, the knees, tips of tibiæ and the tarsi, whitish; scutellum with an æneous tinge .... *H. persimilis.*

   Scape and legs, except coxæ, honey yellow, the tarsi whitish; frons, the dorsum of pronotum and the disk of the mesonotum, æneous .... *H. æneicollis.*

HORISMENUS BISULCUS, sp. nov.

Female.—Length 2.4 mm.; above metallic greenish, the prothorax at the sides, the mesopleura and the coxæ blue, the abdomen black; the scape of the antennæ, except at apex, and the legs, except coxæ, are pale yellowish or yellowish-white. The head and the thorax, except the metanotum, are mostly scaly punctate or punctate, the metanotum being smooth and shining, with two broad longitudinal sulci, extending from base to apex. Wings hyaline, the veins pale yellowish. The abdomen is shorter than the thorax, short ovate, the terminal segments retracted within the large second segment which occupies most of the whole surface; the petiole is opaque, furrowed and a little longer than thick.

Brazil: Chapada, in April.

HORISMENUS BRASILIENSIS, sp. nov.

Female.—Length 1.6 mm.; æneous black, with a bluish tinge on the parapsidis and at the sides of the thorax, the metathorax being brassy; the legs, except the

coxæ, the femora and the last joint of the tarsi, are yellowish-white, the coxæ, the femora except at apex and the abdomen, are dark blue, the last joint of the tarsi being black or brown. The metanotum is smooth, with two longitudinal sulci. The abdomen is ovate, not longer than the thorax, the second segment occupying hardly half its whole surface, the following segments short, nearly equal.

Brazil: Rio de Janeiro, in August.

HORISMENUS CORUMBÆ, sp. nov.

Female.—Length 2 mm. Æneous black, the thorax smooth except the middle mesothoracic lobe; the legs, except the coxæ, are honey yellow, with the knees, tips of tibæ and the tarsi yellowish white. The abdomen is conically pointed, a little longer than the head and thorax united, the second segment being very long, occupying two thirds the whole surface.

Brazil: Corumba, in February.

HORISMENUS PERSIMILIS, sp. nov.

Female.—Length about 0.9 mm. Mostly blue, the scutellum with a decided æneous tinge; flagellum brown black, pubescent; scape and legs, except as hereafter noted, honey yellow, the knees, tips of tibiæ and the tarsi whitish. The abdomen is ovate, not longer than the thorax, the second segment occupying more than half the whole surface.

Brazil: Chapada, in April.

HORISMENUS ÆNEICOLLIS, sp. nov.

Female.—Length 1.6 mm. Mostly blue, the pronotum *above* and the metanotum æneous or metallic greenish, the scape of the antennæ and the legs, except the coxæ, honey yellow. The abdomen is ovate, a little longer than the thorax, the second segment occupying hardly half the whole surface.

Brazil: Santarem.

PELOROTELUS Ashmead, gen. nov.

Allied to *Pleurotropis* Förster, but easily separated by the absence of the lateral metathoracic carinæ, by the metathorax being produced into a long neck at apex and by the abdomen, which is very lengthy-petiolated, the petiole being about as long as the hind femora.

The head is very wide, sublenticular, seen from in front wider than long, the occiput concave; the antennæ are ten-jointed, with one ring-joint, the scape clavate, the pedicel obconical, not much longer than wide at apex, the funicle joints oblong, about thrice as long as thick, briefly pedunculate at apex, clothed with rather long

hairs; the front wings have the marginal vein long, the stigmal vein short, the post-marginal vein not developed; otherwise it is similar to *Pleurotropis.*

PELOROTELUS CŒRULENS, sp. nov.

Male.—Length 1.8 mm. Dark blue, the head and thorax reticulately punctured-the middle mesothoracic lobe and the lateral ridges of the metanotum with a metal, lic greenish tinge; a spot on the knees, extreme apices of tibiæ and the tarsi are yellowish-white; mandibles testaceous. The antennæ are rather long, ten-jointed, the scape elongate, the funicle four-jointed, the joints rather long, loosely joined, with sparse, moderately long hairs, the last joint being fully thrice as long as thick at the middle, the club three-jointed, longer than the first joint of the funicle, the last joint being represented by a little spur. The abdomen is clavate, the petiole, which is attached to the long neck of the metathorax, very long, shagreened, the body smooth and polished. Wings hyaline, the veins pale yellowish.

Brazil: Santarem, in April. One specimen.

Genus ENTEDON Dalman.

ENTEDON ANTANDER Walker.

Entedon antander Walker, Monogr. Chalc., II., 1839, p. 70, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 33.

Brazil: Bahia.

ENTEDON BADIUS Walker.

Entedon badius Walker, Ann. & Mag. Nat. Hist., X., 1843, p. 115, ♂.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 433.—Dalla Torre, Cat. Hym., V., 1898, p. 34.

Chile: Valparaiso.

ENTEDON EMPERAMUS Walker.

Entedon emperamus Walker, Monogr. Chalc.. II., 1839, p. 70, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 36.

Brazil: Bahia.

ENTEDON FLACILLA Walker.

Entedon flacilla Walker, Ann. & Mag. Nat. Hist., X., 1843, p. 115, ♂.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 434.—Dalla Torre, Cat. Hym., V., 1898, p. 37.

Chile: Valparaiso.

ENTEDON HEGELOCHUS Walker.

Entedon hegelochus Walker, Monogr. Chalc., II., 1839, p. 70, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 38.

Brazil: Bahia.

ENTEDON THESTIS Walker.

Cirrospilus thestis Walker, Monogr. Chalc., II., 1839, p. 74, ♀.

Entedon thestis Walker, List Chalc. Brit. Museum, I., 1846, p. 67.— Dalla Torre, Cat. Hym., V., 1898, p. 44.

Brazil: Bahia.

ENTEDON UFENS Walker.

Entedon ufens Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 184, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 45.

Entedon rifens Spinola, Gay: Hist.de Chile, Zool., VI., 1851, p. 433, ♀.

Chile: Isle of Chonos.

Genus DEROSTENUS Westwood.

DEROSTENUS ALCESTAS Walker.

Derostenus alcestas Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 31, ♂.

Entedon alcestas Walker, List Chalc. Brit. Museum, I., 1846, p. 137.— Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 437, ♂.—Dalla Torre, Cat. Hym., V., 1898, p. 32.

Chile: Conception.

TRIBE IV. *Pediobiini.*

PARACRIAS Ashmead, gen. nov.

A genus allied to *Acrias* Walker. Form short and robust, the thorax coarsely reticulately sculptured, the head highly polished, impunctate in front.

The head is very wide, lenticular, wider than the thorax and very thin antero-posteriorly, the occiput concave; the eyes are large, ovate, the malar space short but distinct; the antennæ are nine-jointed, with a ring-joint, the funicle four-jointed, the joints oblong oval, briefly peduncled, hairy, the club two-jointed, the last joint represented by a spur; the thorax is shaped as in *Entedon* but *without* parapsidal furrows, the metathorax being produced into a neck at apex, with a delicate median carina; the abdomen is ovate or conic-ovate, distinctly petiolate, the second segment (first body segment) being very long, occupying most of the surface, the following segments very short, apparently capable of being retracted.

PARACRIAS LATICEPS, sp. nov.

(Plate XXXIX., Fig. 1.)

Female.—Length 1.6–1.8 mm. Æneous black, the thorax with a greenish tinge above, and coarsely reticulately sculptured, the coxæ and legs bluish, the trochanters, a spot on the knees, the extreme apex of tibiæ, and the tarsi yellowish-white. Wings hyaline, the veins yellowish, the postmarginal vein hardly developed, the stigmal vein very short, its knob subsessile. The metathorax is contracted into a

neck at apex and punctate. The abdomen is petiolate, the body in one specimen is conic-ovate, pointed at apex, in another specimen short oval, the terminal segments in the latter evidently being retracted within the very large second segment which occupies nearly the whole surface of the abdomen.

Brazil: Chapada, in August and September.

URODEROSTENUS Ashmead, gen. nov.

This genus is based upon a species from St. Vincent, W. I., and is easily recognized by the strongly exserted ovipositor and by the wings having a long marginal fringe, as in some Mymarids.

AMETALLON Ashmead, gen. nov.

This genus comes very close to *Chrysonotomyia* Ashmead, but is easily recognized by its non-metallic color, and by the very short stigmal vein. The antennæ are nine-jointed, with one ring-joint, the flagellum being filiform, tapering off towards apex, clothed with sparse hairs, the funicle being three-jointed. The abdomen is long, conic-ovate.

AMETALLON CHAPADÆ, sp. nov.

Female.— Length 1.4 mm. Honey yellow, the abdomen mostly of a brownish-yellow, with a transverse fuscous band a little before the middle; eyes brown; antennæ filiform, the flagellum tapering off to a point at apex, with long, sparse hairs. Wings hyaline, fringed, the veins yellowish, the marginal vein very long, fully twice the length of the submarginal, the stigmal vein short but with its knob petiolate, and longer than the postmarginal. The abdomen is conic-ovate, a little longer than the head and thorax united and ends in a short ovipositor.

Brazil: Chapada, in April. Two specimens.

SUBFAMILY II. APHELININÆ.

Genus ASPIDIOTIPHAGUS Howard.

ASPIDIOTIPHAGUS CITRINUS (Craw).

Coccophagus citrinus Craw, Destructive Insects, Sacramento, Cal., 1891.

Aspidiotiphagus citrinus Howard, Insect Life, Vol. VI., 1891, p. 234.—Howard, Lechn. Series, No. 1, U. S. Dept. Agric., p. 31, f. 10.—Dalla Torre, Cat. Hym., V., 1898, p. 224.

Brazil: Bahia, March, 1883 (Albert Koebele).

SUBFAMILY III. TETRASTICHINÆ.

TRIBE I. *Ceratoneurini.*

This tribe is at present known only from Mexico and the West Indies, but representatives will undoubtedly be discovered in South America.

Tribe II. *Tetrastichini.*

Genus TRICHOPORUS Förster.

TRICHOPORUS COLLIGUAYA (Philippi).

Exurus colliguaya Philippi, Stettin. ent. Zeitg., XXXIV., 1873, p. 296; T. 1.—Dalla Torre, Cat. Hym., V., 1898, p. 159.

Chile.

TRICHOPORUS MELLEUS, sp. nov.

Female.—Length 1.8 mm. Honey yellow, punctate, the eyes brown, the abdomen with a blackish spot on each side near the middle, the scape and legs pale yellowish; flagellum long, filiform, hairy; wings hyaline, the veins pale yellowish. The abdomen is cylindrical, pointed at apex and as long as the head and thorax united.

Male.—Length 1.4 mm. Agrees in color with the female except that the blackish spots near the middle of the abdomen unite and form a transverse band, while the veins in the front wings are brownish. The flagellum is long and the hairs are much longer than in the female.

Brazil: Santarem; Chapada.

TRICHOPORUS VIRIDICYANEUS, sp. nov.

Female.—Length 2–2.6 mm. Metallic bluish-green to blue, punctate; scape, trochanters, apices of all femora, and all tibiæ and tarsi, except the last joint, pale yellowish; flagellum brownish-yellow, pubescent; wings hyaline, the veins yellowish. The abdomen is long, cylindrical, twice as long as the thorax, pubescent, the first and second body segments about equal, shorter than the third, the first segment longer than the third, the sixth and seventh short, the seventh conical.

Male.—Length 1.4–1.5 mm. Agrees well with the female, except in the usual sexual differences and in a slight difference in the color of the antennæ and legs: The flagellum is darker with longer hairs and with only *one* ring-joint, while the front and middle femora are dusky only at base. The abdomen is cylindrical, a little longer than the head and thorax united.

Brazil: Chapada, in April. Fourteen females, six male specimens.

TRICHOPORUS PERSIMILIS, sp. nov.

Female.—Length 2.8 mm. Metallic brown black, punctate, the abdomen brown beneath; flagellum brown, hairy; scape, pedicel and legs, including the coxæ, honey yellow, the femora more or less dusky or brownish, especially basally; otherwise it is very similar to *T. viridicyaneus* except that the first body segment of the abdomen is twice the length of the second.

Brazil: Chapada, in April. Two specimens.

Genus TETRASTICHUS Haliday.

TETRASTICHUS ARCHIDEUS (Walker).

Cirrospilus archideus Walker, Monogr. Chalc., II., 1839, p. 75, ♀.

Tetrastichus archideus Walker, List Chalc. Brit. Museum, I., 1846, p. 81.—Dalla Torre, Cat. Hym., V., 1898, p. 10.

Brazil: Bahia.

TETRASTICHUS ATHENAIS (Walker).

Cirrospilus athenais Walker, Monogr. Chalc., II., 1839, p. 72, ♀.

Tetrastichus athenais Walker, List Chalc. Brit. Museum, I., 1846, p. 80.—Dalla Torre, Cat. Hym., V., 1898, p. 10.

Brazil: Bahia.

TETRASTICHUS CACUS (Walker).

Cirrospilus cacus Walker, Monogr. Chalc., II., 1839, p. 75, ♀.

Tetrastichus cacus Walker, List Chalc. Brit. Museum, I., 1846, p. 80.—Dalla Torre, Cat. Hym., V., 1898, p. 12.

Brazil: Bahia.

TETRASTICHUS CLEONICA (Walker).

Cirrospilus cleonica Walker, Monogr. Chalc., II., 1839, p. 69, ♂.

Tetrastichus cleonica Walker, List. Chalc. Brit. Museum, I., 1896, p. 81.—Dalla Torre, Cat. Hym., V., 1898, p. 12.

Brazil: Bahia.

TETRASTICHUS DAIMACHUS (Walker).

Cirrospilus daimachus Walker, Monogr. Chalc., II., 1839, p. 73, ♀.

Tetrastichus daimachus Walker, List. Chalc. Brit. Museum, I., 1846, p. 80.—Dalla Torre, Cat. Hym., V., 1898, p. 13.

Brazil: Bahia.

TETRASTICHUS DEILOCHUS (Walker).

Cirrospilus deilochus Walker, Monogr. Chalc., II., 1839, p. 74, ♀.

Tetrastichus deilochus Walker, List Chalc. Brit. Museum, I., 1846, p. 81.—Dalla Torre, Cat. Hym., V., 1898, p. 13.

Brazil: Bahia.

TETRASTICHUS FEBRUUS (Walker).

Cirrospilus februus Walker, Monogr. Chalc., II., 1839, p. 73, ♀.

Tetrastichus februus Walker, List Chalc. Brit. Museum, I., 1846, p. 80.—Dalla Torre, Cat. Hym., V., 1898, p. 15.

Brazil: Bahia.

TETRASTICHUS NARCÆUS Walker.

Tetrastichus narcæus Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 188, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 427, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 19.

Chile: Coquimbo.

TETRASTICHUS NAUCLES Walker.

Tetrastichus naucles Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 32, ♀. — Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 425, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 19.

Chile: Conception.

TETRASTICHUS NORAX Walker.

Testrastichus norax Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 32, ♀. — Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 425, ♀. — Dalla Torre, Cat. Hym., V., 1898, p. 19.

Chile: Conception.

TETRASTICHUS PHRYNO (Walker).

Cirrospilus phryno Walker, Monogr. Chalc., II., 1839, p. 90, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 83.

Brazil: Bahia.

TETRASTICHUS POLYBÆA Walker.

Tetrastichus polybæa Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 116, ♀♂.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 426, ♀♂.—Dalla Torre, Cat. Hym., V., 1898, p. 21.

Chile: Valparaiso.

TETRASTICHUS SCADIUS Walker.

Tetrastichus scadius Walker, Ann. & Mag. Nat. Hist., XI., 1843, p. 116, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 424, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 22.

Chile: Valparaiso.

TETRASTICHUS VALERUS (Walker).

Cirrospilus valerus Walker, Monogr. Chalc., II., 1839, p. 72, ♀.

Tetrastichus valerus Walker, List Chalc. Brit. Museum, I., 1846, p. 79.—Dalla Torre, Cat. Hym., V., 1898, p. 24.

Brazil: Bahia.

TETRASTICHUS XENOCLES (Walker).

Cirrospilus xenocles Walker, Monogr. Chalc., II., 1839, p. 90, ♀.

Tetrastichus xenocles Walker, List Chalc. Brit. Museum, I., 1846, p. 81.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 427, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 25.

Chile: Chiloe.

TABLE OF NEW SPECIES.

1. Not wholly blue 2

Wholly blue, the tarsi white.

Abdomen conically produced, longer than the thorax .... *T. albitarsis*, sp. nov.

2. Black or blue-black 3

Æneous black, the mesonotum and the scutellum metallic, delicately shagreened; two rows of punctures along the parapsidal sutures; legs, except the coxæ, yellowish, the femora dusky basally; abdomen conic-ovate, not longer than the thorax.................................*T. chapadæ*, sp. nov.

3. Blue-black; the mesonotum microscopically shagreened; a single row of punctures along the parapsidal furrows; legs, except coxæ, honey-yellow, the femora dusky medially and basally; abdomen conically pointed, longer than the head and thorax united......................*T. brasiliensis*, sp. nov.

Black; mesonotum microscopically shagreened; *without* a row of punctures along the parapsidal furrows; scape and legs, except coxæ, honey yellow; abdomen, seen from above, rounded, shorter than the thorax..*T incongruus*, sp. nov.

TETRASTICHUS ALBITARSIS, sp. nov.

Female.—Length 1.5 mm. Wholly dark blue, except the parapsides which are æneous, the base of the antennal scape which is honey yellow, and the tarsi which are yellowish-white except the last joint. The insect is smooth impunctate, except the head which has a few minute punctures on the face; otherwise I can detect no distinct sculpture, although under a very high power the thorax above appears feebly shagreened. Wings hyaline, the veins brown. Abdomen conic-ovate, little longer than the head and thorax united, smooth and shining, depressed above, subcarinate beneath towards base. The flagellum is broken off at the pedicel and cannot be described in detail.

Brazil: Rio de Janeiro, in August. One female specimen.

TETRASTICHUS CHAPADÆ, sp. nov.

Female.—Length 1.8 mm. Æneous black, the mesonotum and scutellum with a metallic greenish tinge, shagreened, the head punctate in front; scape, pedicel and legs, except coxæ, honey-yellow, the femora faintly dusky basally; flagellum brown, pubescent, the first joint of the funicle is the largest, more than twice longer than thick. The middle lobe of the mesonotum has two rows of punctures on each side, along the parapsidal furrows. The metanotum is punctate and has a distinct median carina. The wings are hyaline, the veins yellowish. The abdomen is conic-ovate, smooth impunctate and about the length of the thorax, the first body segment being the longest.

Brazil: Chapada, in April. One female specimen.

TETRASTICHUS BRASILIENSIS, sp. nov.

(Plate XXXIX., Fig. 2.)

Female. — Length 2 mm. Dark blue black, nearly black, with a faint æneous tinge, the head except in the scrobes with thimble-like punctures, the thorax above shagreened, the middle lobe of the mesonotum with a single row of punctures along the parapsidal furrows; scape and legs, except coxæ, honey yellow, the femora

more or less dusky medially, the tarsi paler yellowish. Wings hyaline, the veins yellowish. Abdomen conically pointed, longer than the head and thorax united, depressed above, convex beneath towards base.

Brazil: Chapada, in January. One female specimen.

Tetrastichus incongruus, sp. nov.

Female.—Length 1.5 mm. Black, the head smooth, shining, except some minute punctures, in front near the eyes, the thorax microscopically shagreened, *without* a row of punctures along the parapsidal furrows; scape and legs, except the coxæ honey-yellow, the femora a little darkened. Wings hyaline, the veins yellowish. The abdomen, as seen from above, is rounded, as in the genus *Syn*

Förster, shorter than the thorax; beneath it is carinate.

Brazil: Santarem. One female specimen.

Subfamily IV. Elachertinæ.

Tribe I. *Euplectrini.*

Genus EUPLECTUS Westwood.

TABLE OF SPECIES.

1. Æneous black.
    - All coxæ yellowish-white 2
    - Hind coxæ black.
        - Legs, except the hind coxae and the hind femora, honey yellow, the hind femora brownish at the thickened portion. Female .... *E. brasiliensis.*
2. Legs yellowish-white.
    - Antennæ wholly pale yellow or with the flagellum wholly brown 3
    - Antennæ not wholly pale yellow, the six last joints brown; basal half of abdomen beneath and above, testaceous, the apical half black, as well as a streak at sides basally; clypeus and malar space black .... *E. corumbæ.*
3. Antennæ wholly pale yellowish; scutellum basally purplish; metallic green apically; a triangular area at base of metanotum connected with a median carina; body of abdomen rufous basally; clypeus reddish; malar space black. Male .... *E. solitarius.*
    - Antennæ not wholly pale, the pedicel and flagellum brown; scutellum wholly black; clypeus and cheeks testaceous; body of abdomen beneath, except just at apex, and above basally, rufous. Male .... *E. chapadæ.*

Euplectrus brasiliensis, sp. nov.

Female.—Length 1.6 mm. Æneous black, the head and thorax with long, sparse hairs; clypeus honey yellow; antennæ, except faintly toward apex, and the legs, except the hind coxæ and the hind femora, honey yellow, the hind coxæ black, the hind femora more or less brownish except at base. Wings hyaline, pubescent, the tegulæ and the veins pale yellowish. The abdomen is black, with a

reddish spot basally both above and beneath, the petiole shagreened. The joints of the funicle are long, the last joint being fully thrice as long as thick.

Brazil: Porto Branca, in April. One specimen.

EUPLECTRUS CORUMBÆ, sp. nov.

Female.— Length 1.5 mm. Æneous black, the clypeus black; first three joints of antennæ and the legs, including all coxæ, pale honey yellow or yellowish-white; rest of antennæ brown; basal half of abdomen beneath and above testaceous; otherwise hardly distinguishable from *E. brasiliensis*, except that the last three joints of the funicle are much shorter than in that species, being only a little longer than thick.

Brazil: Corumba, in May. One specimen.

EUPLECTRUS SOLITARIUS, sp. nov.

Male.— Length 2 mm. Æneous black, the clypeus testaceous; antennæ and legs, including coxæ, yellowish-white; body of abdomen rufous at basal half above and with a small spot of the same color beneath; the petiole is more than twice as long as thick, shagreened.

Brazil: Rio de Janeiro, in November. One specimen.

EUPLECTRUS CHAPADÆ, sp. nov.

Male.— Length 1.6 mm. Æneous black, the clypeus and the cheeks testaceous; flagellum, including the pedicel brown; scape of antennæ and the legs, including all coxæ, yellowish-white; body of abdomen, except apically and a streak along the sides, rufous or testaceous.

Brazil: Chapada, in April. Two specimens (one badly broken).

TRIBE II. *Ophelinini.*

Genus ARDALUS Howard.

ARDALUS HOWARDII, sp. nov.

Male. — Length 1.3 mm. Black; the mandibles and the flagellum are testaceous; the trochanters, base and tips of femora, base of hind tibiæ, and rest of the legs pale yellowish, the femora, except as noted, and the apical two thirds of the hind tibiæ being brown or brown black. The head is smooth, impunctate, the eyes grayish-brown, pubescent, the ocelli red; flagellum filiform, tapering off towards apex, the funicle joints loosely joined, the last fully twice longer than thick, the preceding joints a little longer. The thorax is rather coarsely rugulose, the metathorax polished, with two median carinæ and some wrinkles on each side. Wings hyaline,

with a faint discal spot beneath the apex of the stigmal vein, the veins pale yellowish. The abdomen in outline is nearly round, depressed, the petiole long, smooth and shining, the first and second body segments occupy half the whole surface, the second the larger, the following short, about equal.

Brazil: Chapada, in May. One specimen. Named in honor of Dr. L. O. Howard.

Genus LEUCODESMIA Howard.

Leucodesmia flaviceps, sp. nov.

Female. — Length 2.3 mm. Head yellow, the eyes brown, pubescent; thorax and abdomen black; scape and the legs, except coxæ and the front femora medially, honey yellow, the coxæ black, the front femora medially brownish; flagellum brown black, subcompressed, the joints of the funicle loosely joined, the first joint the longest, about twice as long as wide, the last joint only a little longer than wide. The head is smooth impunctate, except a slight shagreening on the frons above; the thorax is scaly punctate, the metanotum being smooth, with a median carina. Wings hyaline, the veins yellowish. The abdomen is ovate, depressed, not longer than the thorax.

Brazil: Chapada, in April. One specimen.

ELACHERTOMORPHA Ashmead, gen. nov.

This genus resembles *Elachertus* Spinola, and could be easily mistaken for it, except that the hind tibiæ have *two* apical spurs. From *Leucodesmia* Howard, it is separated by the antennæ being ten-jointed and by having the scutellum grooved.

Elachertomorpha flaviceps, sp. nov.

Female.—Length 1.5 mm. Head, except the eyes and two converging black lines on the scrobes, honey yellow; thorax and abdomen æneous black, the former shagreened, with the scutellum rugulose and the metanotum carinate; scape of antennæ and the legs, except as noted, honey yellow, the middle and hind coxæ black, the front and middle femora basally, more or less dusky, the hind femora medially and the apex of the hind tibiæ brownish. Wings hyaline, the veins yellowish. The abdomen is rounded, smooth and shining, shorter than the thorax, with a short petiole.

Brazil: Santarem. One specimen.

SYMPIESOMORPHA Ashmead, gen. nov.

This genus has the general habitus of *Sympiesis* Förster, with which I at first confused it, but one may easily distinguish it by the *two* spurred hind tibiæ and by the

distinct parapsidal furrows. It also resembles *Stenomesius* Westwood but is easily separated by the pubescent eyes, and by the longer and more sessile abdomen.

SYMPIESOMORPHA BRASILIENSIS, sp. nov.

Female.—Length 3 mm. Black; the abdomen is æneous black, with a large rufous spot at base both above and beneath; scape and legs, including the coxæ, honey yellow, the tips of the coxæ and the trochanters whitish; flagellum black. Wings hyaline, the tegulæ and veins pale yellowish. The head is smooth, with a few minute punctures in front; thorax reticulately punctate, clothed with whitish hairs, the metanotum with a sharp median carina. The abdomen is ovate, depressed, about as long as the head and thorax united.

Brazil: Chapada, in September. One specimen.

SYMPIESOMORPHA OBSCURA, sp. nov.

Female.—Length 1.8 mm. Black with a bluish tinge, the head in front and the metapleura metallic greenish, the abdomen æneous black, the dorsum with a yellowish band before the middle, the base before the band being blue, the venter with a yellowish spot near the middle; the scape and legs, except the coxæ and most of the femora, are pale yellowish or yellowish-white; flagellum black. Wings hyaline, the veins yellowish.

Brazil: Corumba. One specimen.

Genus STENOMESIUS Westwood.

STENOMESIUS DIMIDIATUS, sp. nov.

(Plate XXXIX., Fig. 3.)

Female.—Length 2.1 mm. Flavo-testaceous, the head in front below pale yellowish, the scutellum subfuscous, the metathorax and apical half of the abdomen black; scape and legs, including the coxæ, pale yellowish; wings hyaline, the front pair with a fuscous spot from the apex of the stigmal vein. The head is smooth, the thorax, and especially the middle mesothoracic lobe, is rugulose, the scutellum coriaceous, the furrows with large punctures; the metanotum has a sharp median carina and is transversely regulose on each side. The abdomen is ovate, smooth and polished, except the petiole, which is finely rugulose.

Brazil: Chapada. One specimen.

ALOPHUS Ashmead, gen. nov.

This genus falls in between *Diglyphomorpha* Ashm. and *Sympiesis* Först.; it comes nearest to the first mentioned but differs in not being metallic, by having ten-jointed

antennæ, and by having only two dorsal grooved lines on the scutellum. In *Sympiesis* the antennæ are ten-jointed, but it is metallic and the scutellum is without dorsal grooved lines.

ALOPHUS BRASILIENSIS, sp. nov.

Female.—Length 2.8–3 mm. Honey yellow, the eyes brown, the flagellum and the apex of the abdomen above, black, the legs yellowish, the tarsi whitish, the apical half or more of hind tibiæ sometimes fuscous. Wings hyaline, with a fuscous cloud beneath the stigmal vein.

The abdomen is long, conical, depressed above, convex beneath, usually considerably longer than the head and thorax united, black or blackish at apex above.

Male.—Length 2 mm. Head, except the clypeus, the lower part of the cheeks and the mouth parts, black, the thorax honey yellow, with the disk of the scutellum, the mesopleura and the metathorax black; flagellum light brown; scape and the legs pale yellowish. The abdomen is oblong, briefly petiolate, depressed, about the length of the thorax, the basal part of the dorsum yellowish.

Brazil: Chapada, in April; Rio de Janeiro, in September.

TRIBE III. *Elachertini.*

Genus ELACHERTUS Spinola.

ELACHERTUS CATTA (Walker).

Eulophus catta Walker, Monogr. Chalc., II., 1839, p. 71, ♀.
Elachestus catta Walker, List Chalc. Brit. Museum, I., 1846, p. 69.
Elachistus catta Dalla Torre, Cat. Hym., V., 1898, p. 77.

Brazil: Bahia.

ELACHERTUS GYES (Walker).

Eulophus gyes Walker, Monogr. Chalc., II., 1839, p. 89, ♂.
Elachestus gyes Walker, List Chalc. Brit. Museum, I,, 1846, p. 69.
Elachistus gyes Dalla Torre, Cat. Hym., V., 1898, p. 78.

Chile: Isle of Chiloe.

SUBFAMILY V. EULOPHINÆ.

TRIBE I. *Eulophini.*

Genus SYMPIESIS Förster.

Genus EULOPHUS Geoffroy.

EULOPHUS? LAONOME Walker.

Eulophus laonome Walker, Monogr. Chalc., II., 1839, p. 90, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 431, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 62.

Chile: Isle of Chiloe.

EULOPHUS RHIANUS Walker.

Eulophus rhianus Walker, Ann. & Mag. Nat. Hist., X., 1842, p. 116, ♀.—Spinola, Gay: Hist. de Chile, Zool., VI., 1851, p. 430, ♀.—Dalla Torre, Cat. Hym., V., 1898, p. 67.

Chile: Valparaiso.

FAMILY LXXII. TRICHOGRAMMIDÆ.

Genus PENTARTHRON Riley.

PENTARTHRON BRASILIENSIS, sp. nov.

Female.—Length 0.4 mm. Head and thorax above uniformly honey-yellow, the temples, cheeks, mouth parts, sides of thorax and the abdomen beneath yellowish-white, the eyes brown; the antennæ, except the club which is dusky, and the legs are very pale or yellowish-white; the pedicel is hardly longer than thick, much shorter than the first joint of the funicle which is conical and more than twice olnger than thick at apex, the second funicle joint being small, annular, the club large, fusiform, as long as the scape. The wings are hyaline, with a long marginal fringe, the front wings with the pubescence arranged in eight hair lines.

Type.—Cat. No. 6596, U. S. N. M.

Brazil: Bahia. Taken on cotton, March, 1883, by Mr. Albert Koebele.

FAMILY LXXIII. MYMARIDÆ.

SUBFAMILY I. GONATOCERINÆ.

I have seen no representative of this subfamily from South America, although it must be well represented by many species in several genera.

SUBFAMILY II. MYMARINÆ.

Genus POLYNEMA Haliday.

POLYNEMA BRASILIENSIS, sp. nov.

Female.—Length 1 mm.; ovipositor about one third the length of the abdomen. Polished black; antennæ brownish-fuscous, with the scape, pedicel, first joint of funicle, the apex of the fourth and base of fifth funicle joints, yellow; the legs except as noted, and the abdominal petiole pale yellow, the hind femora toward apex and the apical two fifths of the hind tibiæ, dusky or fuscous.

Brazil: Chapada, in April. One specimen.

POLYNEMA RUFESCENS, sp. nov.

Male.—Length 0.8 mm. Reddish-brown, the eyes and the flagellum brown black; scape, pedicel and legs, except the hind tibiæ which are fuscous, honey yellow; the abdomen towards the apex is tinged with fuscous.

Type.—Cat. No. 6595 U. S. N. M.

Brazil: Pernambuco, February, 1883 (Mr. A. Koebele).

LITERATURE AND ABBREVIATIONS.

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Say.— Say (Thomas). (*See* Serials.)
Say, Lec. Ed.— Say (T.). Complete writings of Thomas Say on the Entomology of North America. Edited by John L. Le Conte, M.D. 2 vols. New York, 1859.
Schellenb.—Schellenberg (Johann Rudolf). Genres de Mouches diptères, représéntes en 42 pl. col. projectées et dessinées et expliquées par deux amateurs de l' entomologìe. 1803.
Schlecht.— Schlechtendal (Dr. H. R.). (*See* Serials.)
Schlett.— Schletterer (Dr. A.).
Schäff., Forts. Germ.— Herrick-Schäffer (G. A. W.). Fortsetzung von Panzer, Faunæ Insectorum Germanicæ initia. Ratisbon, 1829–1844.
Shipp.— Shipp (John).
Scop.— Scopoli (J. A.).
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Scudd., But.—Scudder (Saml.). Butterflies of the Eastern United States and Canada. Cambridge, 1889. Report of Progress, Geological Survey of Canada.
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Six.—Six (G. A.). (*See* Serials.)

Sitz. d. naturf. Gesell. zu Leipzig.—Sitzungsberichte der Naturforschenden Gesellschaft zu Leipzig. 8vo.
Sm.—Smith (Emily). (*See* Serials).
Sm.—Smith (Fredr.). (*See* Serials.)
Soc. Ent.—Societas Entomologica. Organ für den internationalen Entomologen-Verein. Zurich. 4to.
Sp. Nov. Hym. disp. Meth. (*See* Fallen.)
Spin.—Spinola (M.).
Spin. Ins. Lig.—Spinola (Marquis M.). Insectorum Liguriæ species novæ aut rariores. 2 vols. Genoa, 1806–1808.
St.-Farg.—St. Fargeau (A. L. M. Le Peletier, Comte de). (*See* Le Peletier.)
Stadelm.—Stadelmann (A.).
Stef.—Stefani (Theodosio).
Stefani, Nat. Sic.—Stefano (Theodosio de). Il Naturalista Siciliano: Giornale delle Scienze Naturali, Ragusa, Palermo.
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Stoll (O.). (*See* Serials.)
Svensk. Ak. Handl.-Kongliga Svenska Vetenskaps-Akademiens Handlingar. Stockholm, 1780 *et seq.*
Swed.—Swederus (N. S.). (*See* Serials.)
Symb. physic.—Symbolæ physicæ, seu icones et descriptiones insectorum, quæ ex itinere per Africam borealem et Asiam F. G. Hemprich et D. H. Ehrenberg studio novæ aut illustratæ radiarum. Percensuit Dr. Klug. Berolini, Mittler, 1829–1845. Fol. c. 50 tab. col.
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Thoms.—Thomson (C. G.). (*See* Serials.)
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Walck., Fn. Paris. — Walckenaër (Baron C. A. de). Faune Parisienne. Histoire Abrégée des Insectes des Environs de Paris. 2 vols. Paris, 1802.
Walker. — Walker F. (Francis). (*See* Serials.)
Walk. Mongr. Chalc. —Monographia Chalciditum by Francis Walker. 2 vols. London, 1839.
Walk., Notes on Chalc. — Notes on Chalcidiæ. By Francis Walker. 5 Pts. 1871.
Walsh. — Walsh (Benj. D.). (*See* Serials.)
Walsh. — Walsh (Benjamin D.).
Web. und Mohr, Beitr. — Archiv für die systematische Naturgeschichte. Edited by F. Weber and W. H. Mohr. Leipzig, 1804. Continued under the title: Beiträge zur Naturkunde, etc. 2 vols. Kiel, 1805 and 1810.
Westw. — Westwood (Prof. John O.). (*See* Serials.)
Westw., Intr. — Westwood (J. O.). An Introduction to the Modern Classification of Insects. 2 vols. London, 1839–40.
Westw., Thes. Ent. Ox. — Thesaurus Entomologicus Oxoniensis, etc. Oxford, 1874.
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Willem. — Willem (Victor). (*See* Serials.) Bull. Sci. d. France et d. Belgique, 1897.
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Zehnt. — Zehnter (L.).
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Zool. Rec. — The Zoological Record. London. 8vo, I., 1864 *et seq.*
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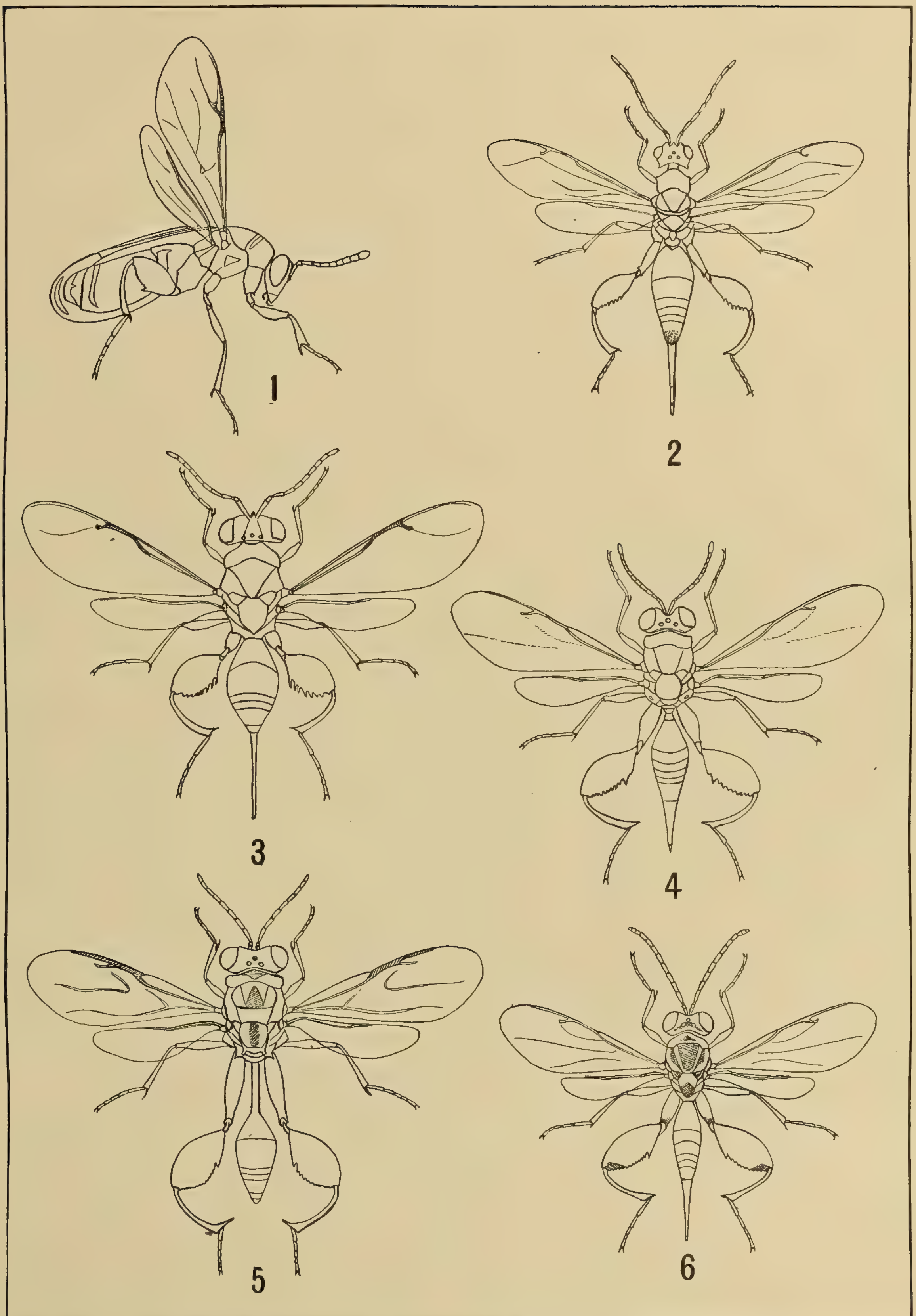
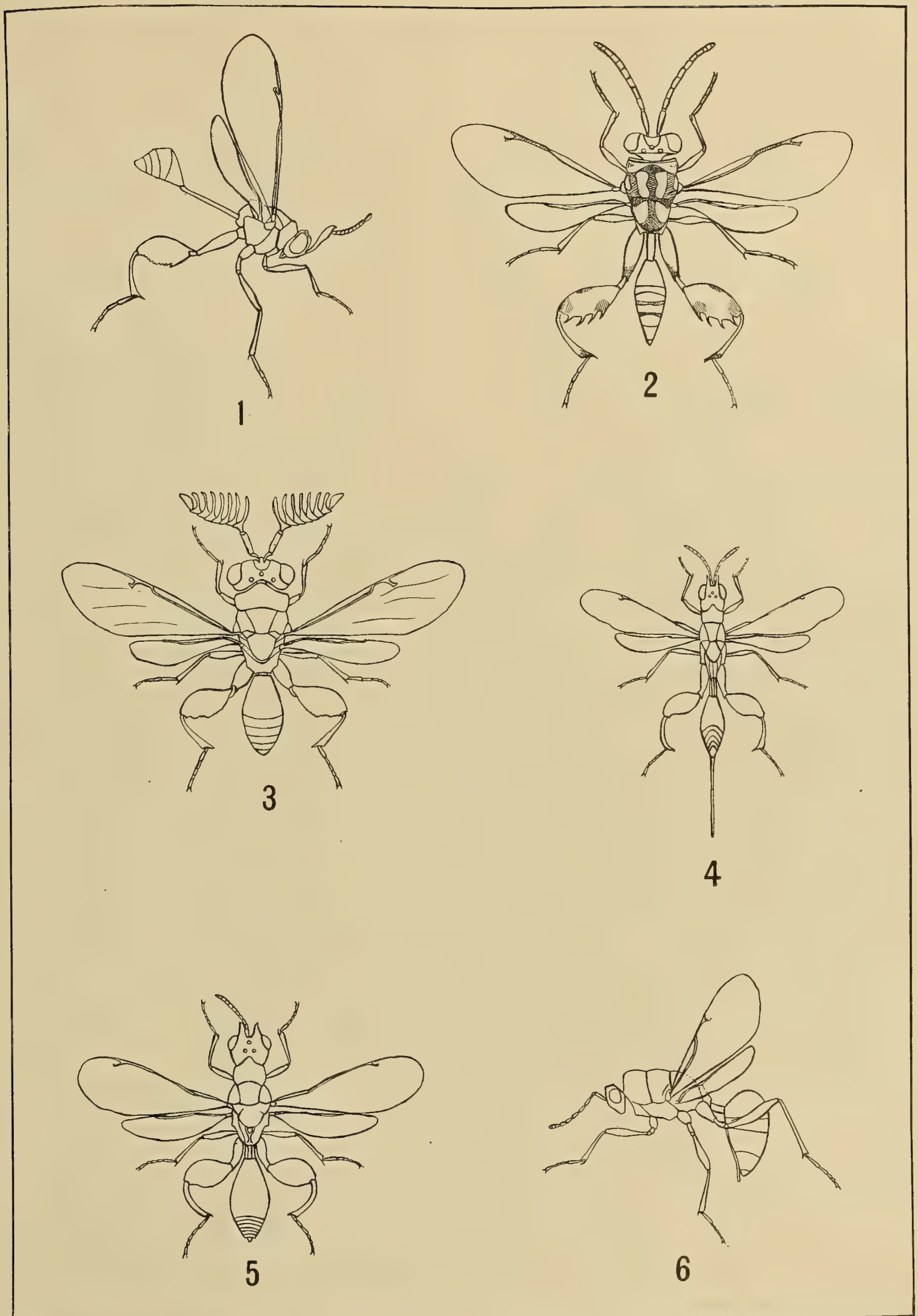
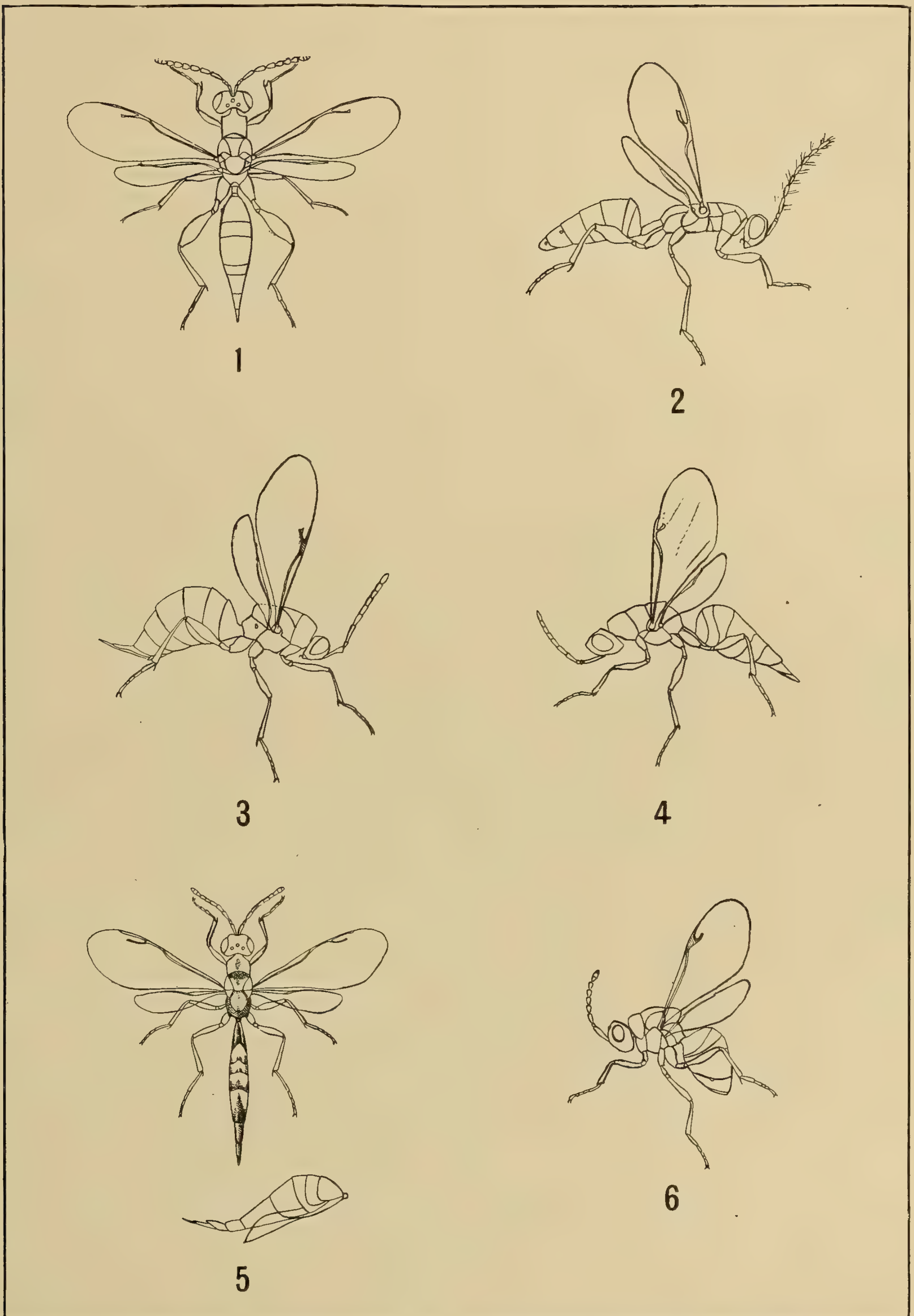


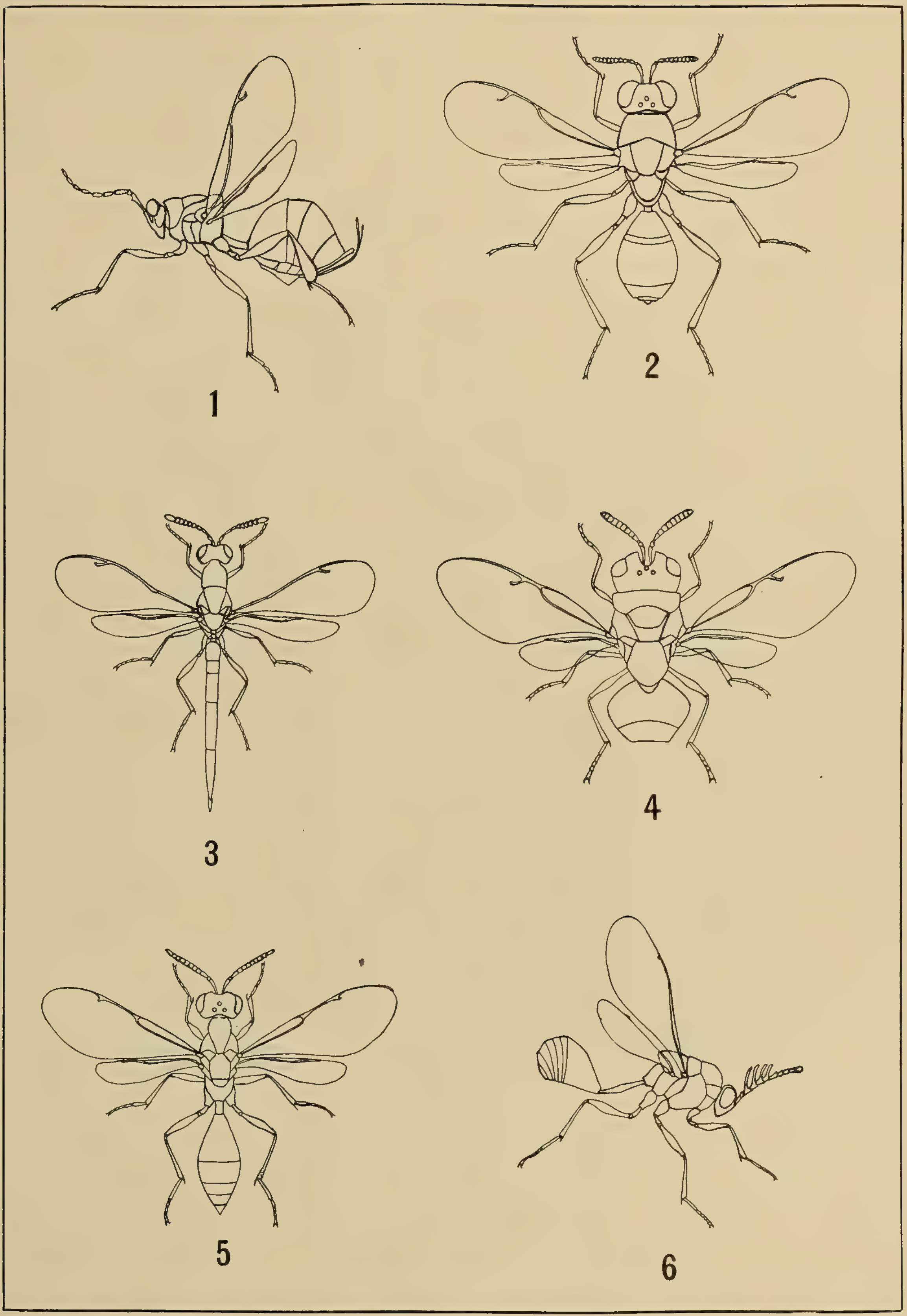
1. *Leucospis enderleini* Ashmead, ♀.
2. *Thaumatelia pulchripennis* Ashmead, ♀.
3. *Epitelia stylata* Walker, ♀.
4. *Eustypiura bicolor* Ashmead, ♀.
5. *Xanthomelanus dimidiatus* Fabricius, ♂.
6. *Eustypiura sexmaculata*, Ashmead, ♀.



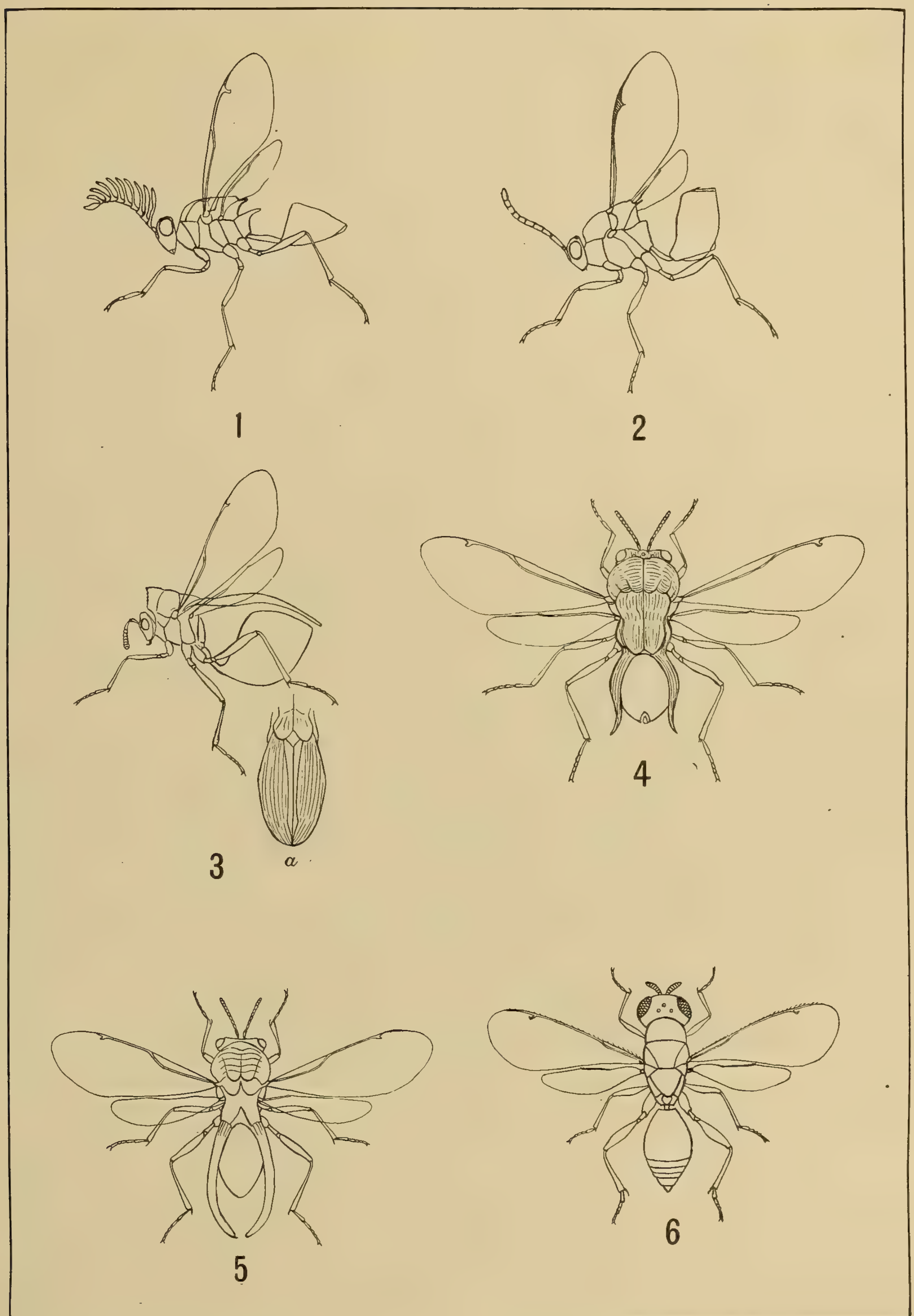
1. *Ceratosmicra petiolata* Ashmead, ♂.
2. *Tetrasmicra crocata* Walker, ♂.
3. *Hippota pecticornis* Latreille, ♂.
4. *Hontalia cameroni* Ashmead, ♀.
5. *Hontalia kirbyi* Ashmead, ♂.
6. *Aximopsis morio* Ashmead, ♀.



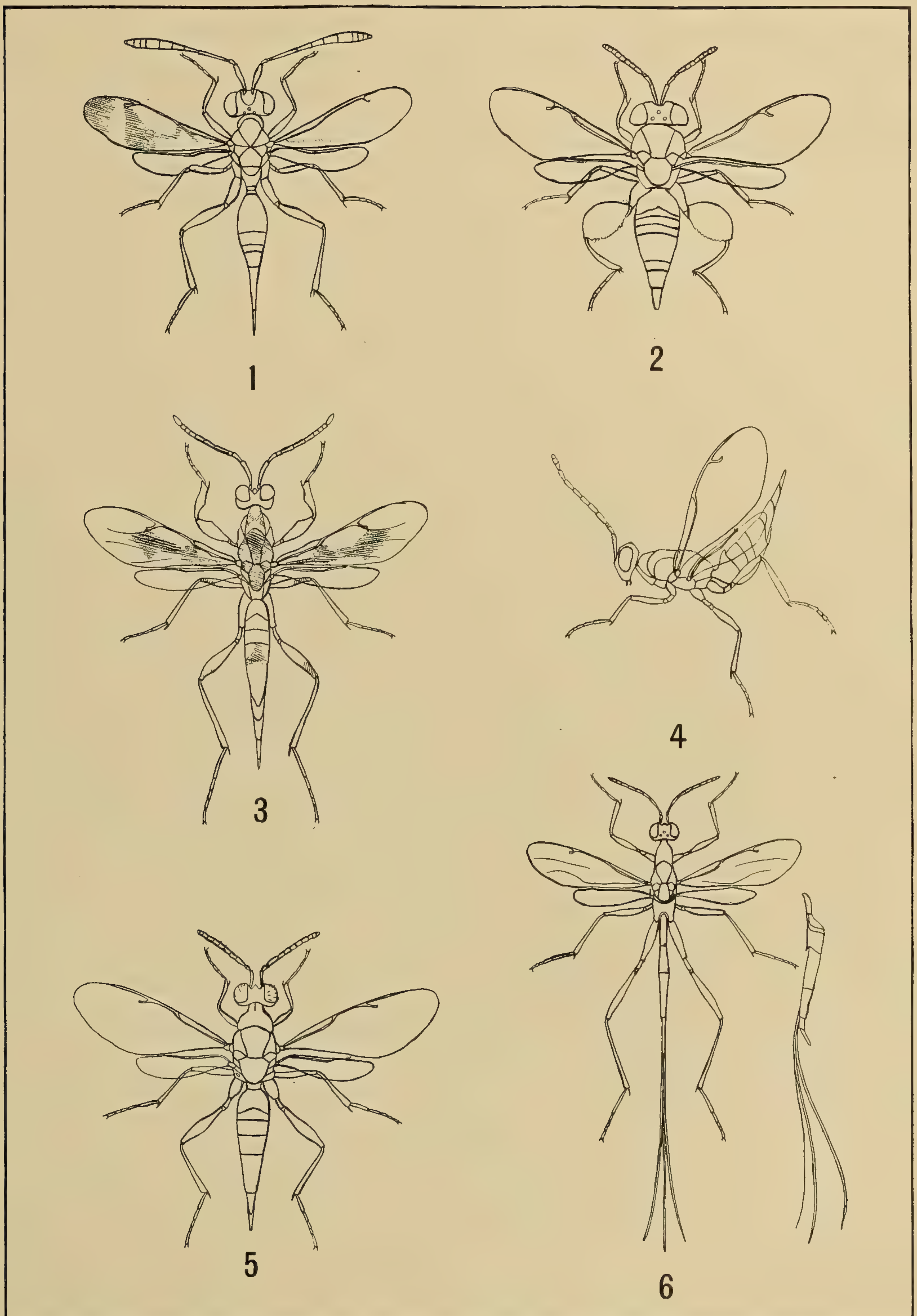
1. *Isosomodes brasiliensis* Ashmead, ♀.
2. *Isosomodes nigriceps* Ashmead, ♂.
3. *Chryseida æneiventris* Ashmead, ♀.
4. *Bephrata striatipes* Ashmead, ♀.
5. *Aximogastra bahiæ* Ashmead, ♀.
6. *Prodecatoma flavescens* Ashmead, ♀.



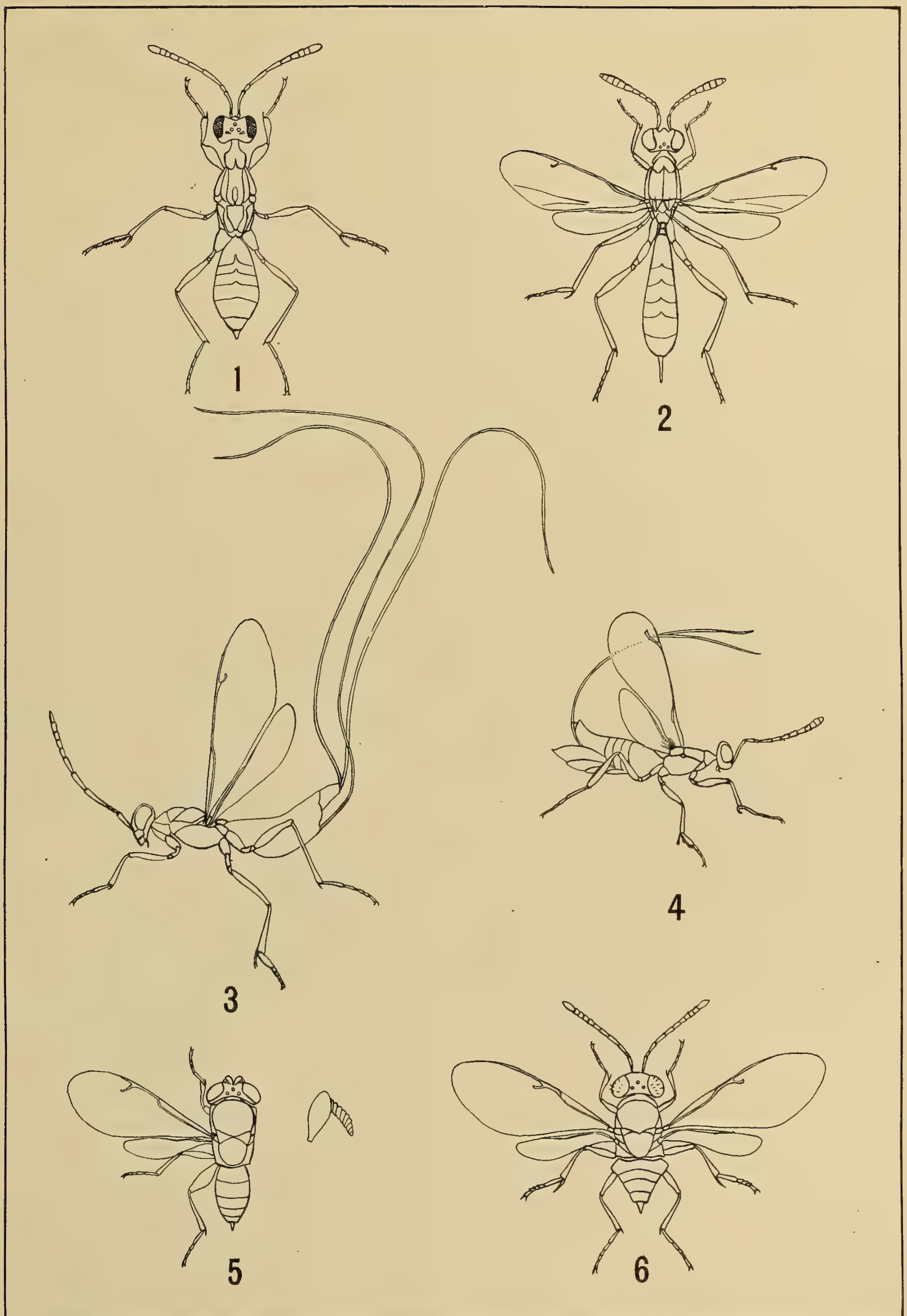
1. *Eudoxinna transversa* Walker, ♀.
2. *Neorileya flavipes* Ashmead, ♀.
3. *Macrorileya œcanthi* Ashmead, ♀.
4. *Perilampus brasiliensis* Ashmead, ♀.
5. *Orasema rapo* Walker, ♀.
6. *Pseudochalcura nigrocyanea* Ashmead, ♀.



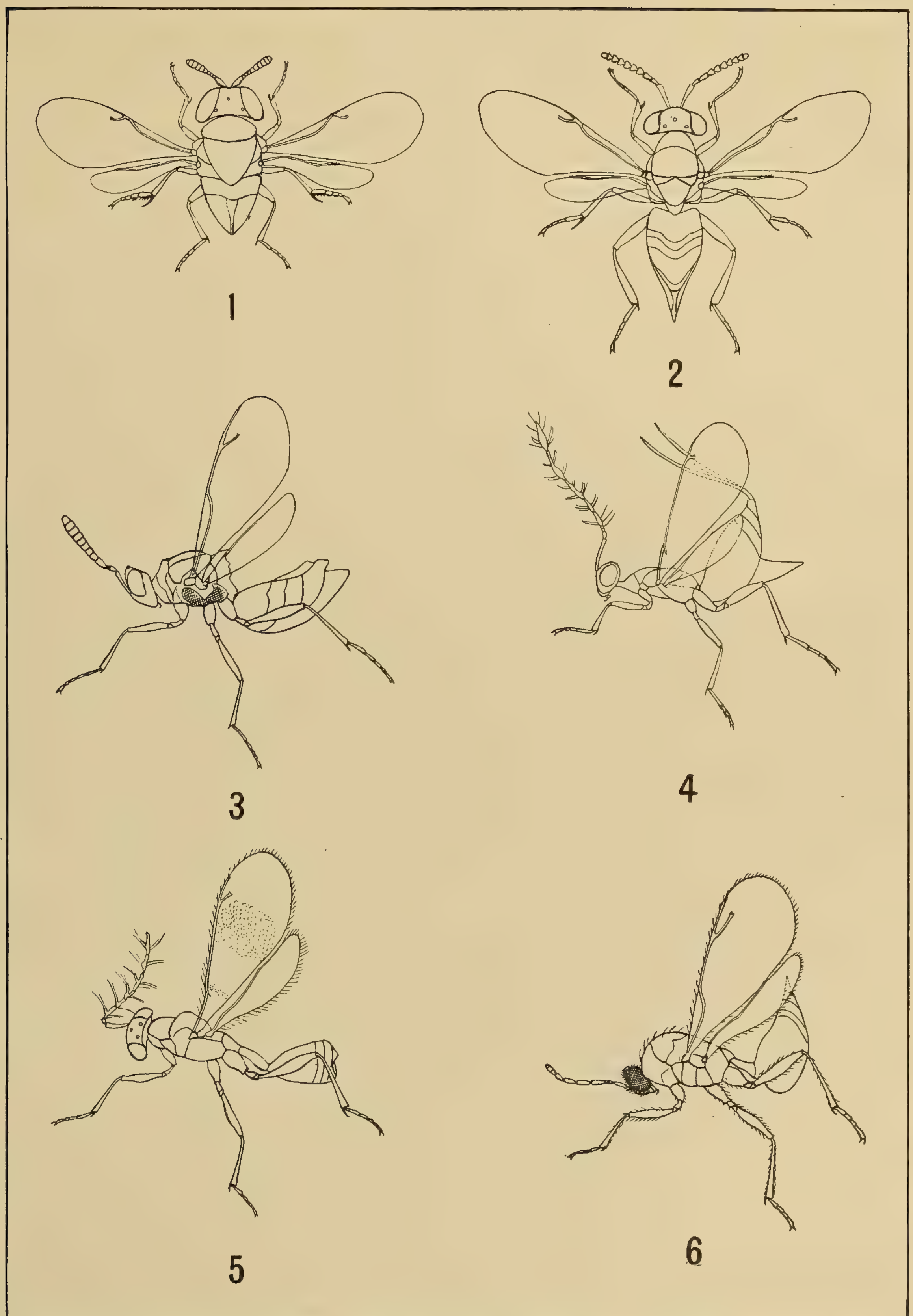
1. *Tetramelia plagiata* Walker, ♂.
2. *Stibula nigriceps* Ashmead, ♂.
3. *Dicœlothorax platycerus* Ashmead, ♀.
   a, scutellum seen from above.
4. *Kapala splendens* Ashmead, ♀.
5. *Lasiokapala serrata* Ashmead, ♀.
6. *Herbertia howardi* Ashmead, ♀.



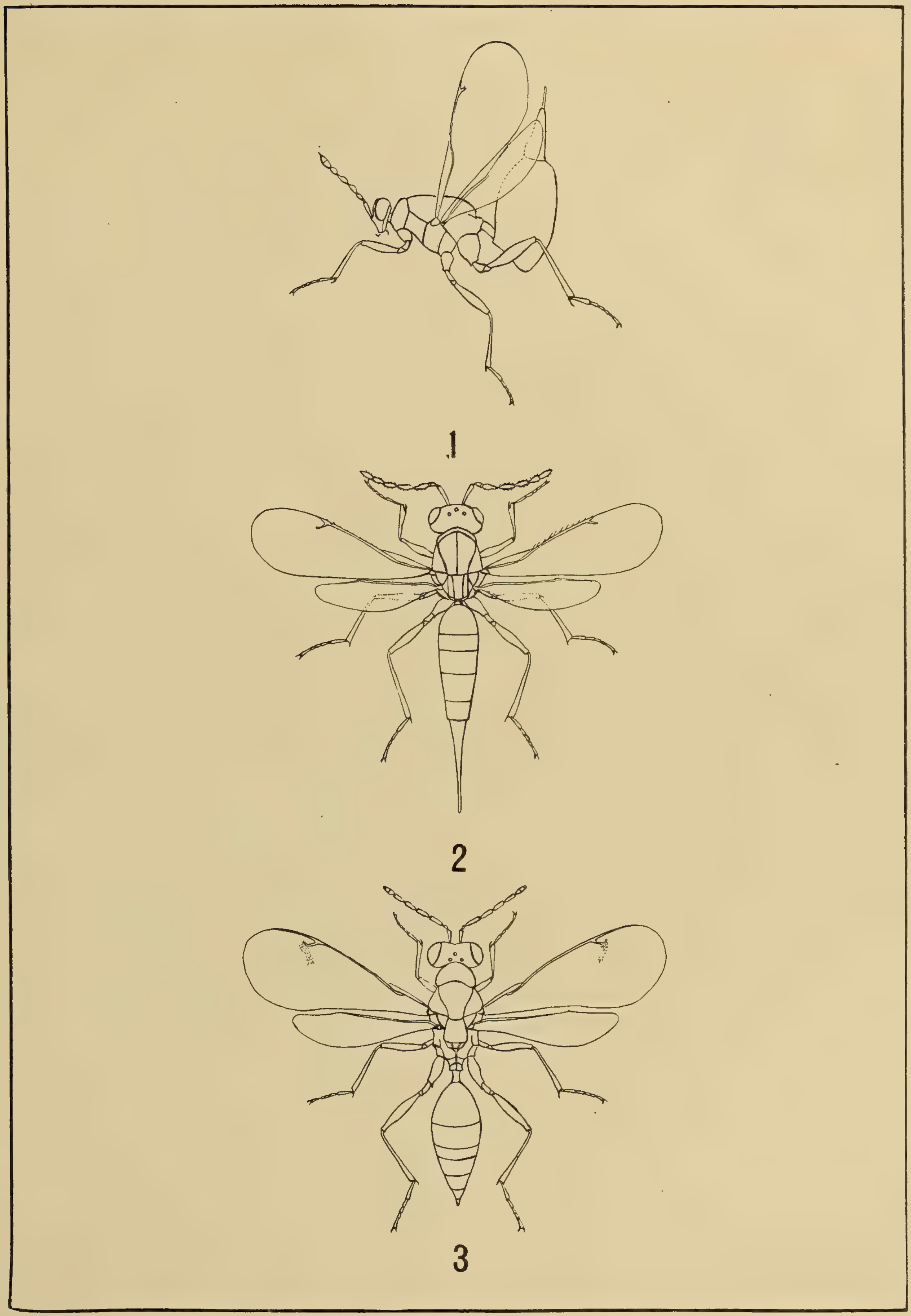
1 *Lelaps abdominalis* Ashmead, ♀.
2. *Chalcedectes annulipes* Ashmead, ♀.
3. *Lycisca ignicauda* Westwood, ♀.
4. *Trigonoderus brasiliensis* Ashmead, ♀.
5. *Epistenia basalis* Walker, ♀.
6. *Pelecinella howardi* Ashmead, ♀.



1. *Ooderella smithi* Ashmead, ♀.
2. *Macreupelma brasiliensis* Ashmead, ♀.
3. *Phlebopenes pertyi* Ashmead, ♀.
4. *Encyrtaspis brasiliensis* Ashmead, ♀.
5. *Trichencyrtus robustus* Ashmead, ♀.
6. *Parencyrtus brasiliensis* Ashmead, ♀.



1. *Ænasius chapadæ* Ashmead, ♀.
2. *Hemencyrtus herberti* Ashmead, ♀.
3. *Acanthometopon clavicorne* Ashmead, ♀.
4. *Urœntedon verticillata* Ashmead, ♀.
5. *Hoplocrepis bifasciata* Ashmead, ♂.
6. *Eulophopteryx chapadæ* Ashmead, ♀.



1. *Paracrias laticeps* Ashmead, ♀. 2. *Tetrastichus brasiliensis* Ashmead, ♀.
3. *Stenomesius dimidiatus* Ashmead, ♀.

SPECIAL INDEX TO MEMOIR IV.

188616

GENERAL INDEX.

N. B. A special index, covering all the material described in the paper of Dr. William H. Ashmead on the Chalcidoidea, has been provided, and will be found on p. 533.

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DIPLODOCUS MARSH,

ITS OSTEOLOGY, TAXONOMY, AND PROBABLE HABITS, WITH A RESTORATION OF THE SKELETON.

BY J. B. HATCHER.

PITTSBURGH.

PUBLISHED BY THE AUTHORITY OF THE BOARD OF TRUSTEES OF THE

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CLASSIFICATION OF THE CHALCID FLIES

OR THE

SUPERFAMILY CHALCIDOIDEA,

WITH DESCRIPTIONS OF

NEW SPECIES IN THE CARNEGIE MUSEUM,

COLLECTED IN SOUTH AMERICA BY

HERBERT H. SMITH.

BY WILLIAM HARRIS ASHMEAD, A.M., SC.D.,
ASSISTANT CURATOR, U. S. NATIONAL MUSEUM.

TITLE PAGE, TABLE OF CONTENTS AND INDEX OF VOL. I.

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